Mechanical World

AND ENGINEERING RECORD

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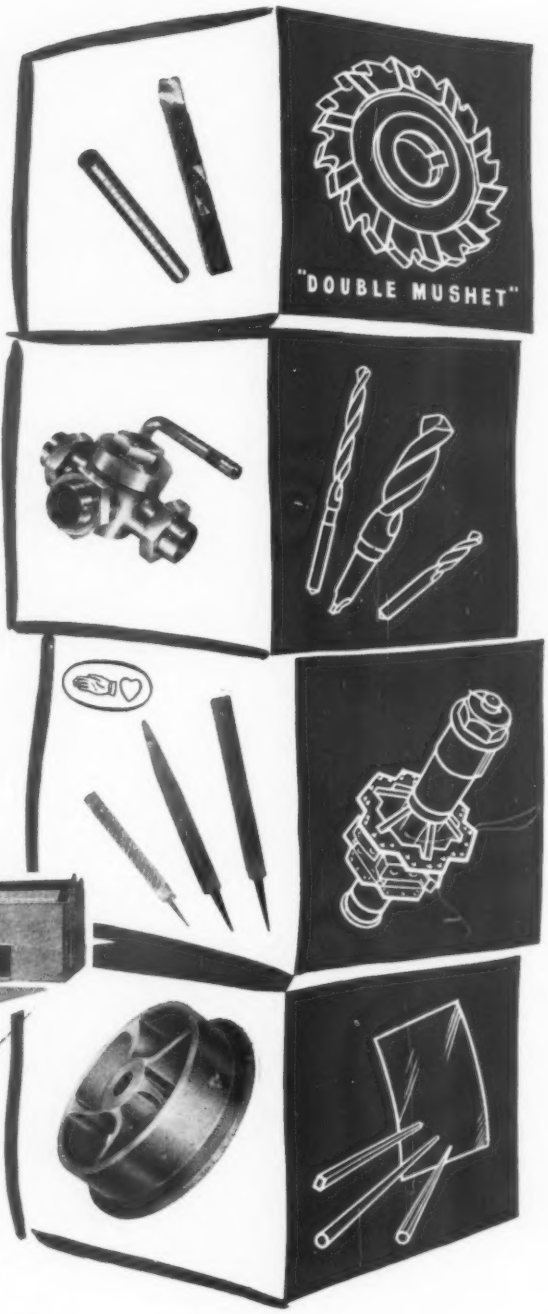
OSBORN PRODUCTS

Integrated experience from over a century of craftsmanship has made the name of *Osborn* world-famous as a hallmark of quality in the manufacture of fine steels and steel products.

Products in alloy, stainless and tool steels are manufactured throughout within the same organisation, and include castings by general foundry and precision methods, forgings and engineers' cutting tools.



STEELMAKERS · STEELFOUNDERS · ENGINEERS' TOOLMAKERS

SAMUEL OSBORN & CO., LIMITED

CLYDE STEEL WORKS, SHEFFIELD

GAMAX

One of the hundreds of Gamax Gear Units installed in the factory of W. D. & H. O. Wills.

THE GREAT LITTLE **Gear Unit**

gives smooth, efficient service in light industry

For packaging cigarettes and for almost any other light industrial tasks requiring a range of ½ to 1½ max. H.P. (18–896 r.p.m. output speed) these compact Gamax Gear Units excel. Incorporating straight line drive with high quality Durangus non-metallic planet pinions they provide really silent, vibration-free operation . . . *and because conventional oilbath lubrication is completely dispensed with, all fear of leakage or contamination is eliminated.*

The sealed bearing assembly is prepacked with grease to ensure at least two years trouble free running under normal conditions . . . and these compact units can be mounted at *any* angle without in any way impairing their efficiency.

Competitive in price, these outstanding gear units are available to give efficient, quiet and trouble-free service in any light industrial application.

ALSO IN REGULAR PRODUCTION ARE:—

Spur and Helical Gears up to 78" diameter.
Double Helical Gears up to 5 ft. diameter.
Worm Gears up to 24" centres.
Bevel Gears up to 5 ft. diameter.
Profile Ground Spur, Helical and Worm Gears.
Durangus and Peak Non-metallic Silent Gears.
Rawhide Silent Pinions.

GEAR UNITS OF ALL KINDS TO SPECIAL REQUIREMENTS.

GEORGE ANGUS & Co LTD
GEAR DIVISION
PRINCE CONSORT ROAD - HEBBURN CO. DURHAM
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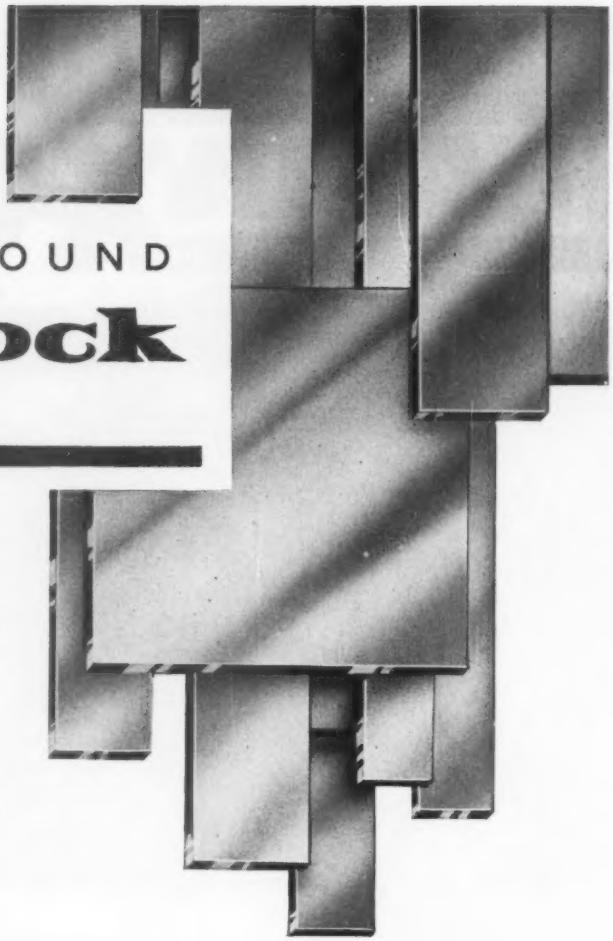
A53/60

SANDERSON'S

PRECISION GROUND

Flat Stock



★ PITHO brand NEWHALL flat stock is a high grade alloy tool steel fully softened for ease in sawing, drilling, machining, etc.

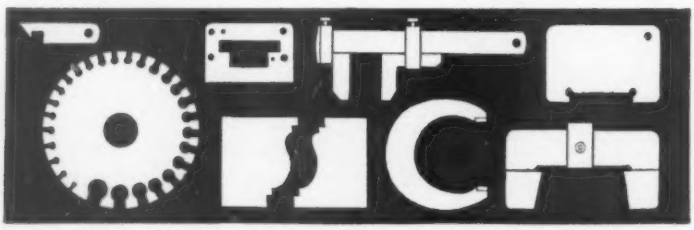
★ Accurately ground in width and thickness with a standard tolerance of plus or minus ·001″ in thickness

★ A particularly useful and economical material for making precision tools, punches, dies, gauges, jigs, templates and machine parts, etc.

★ High wear-resistance after heat-treatment

★ Wide range of standard sizes from $\frac{1}{8}$″ to 12″ wide, 18″ and 24″ lengths

★ **All sizes individually wrapped in protective packages bearing full heat-treatment instructions**



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Tool and Die Steels
Constructional Steels and Strip
Saws for wood and metal
Machine Knives
Engineers' cutting tools
Heliocentric Speed Reducers

SANDERSON BROTHERS AND NEWBOULD LIMITED

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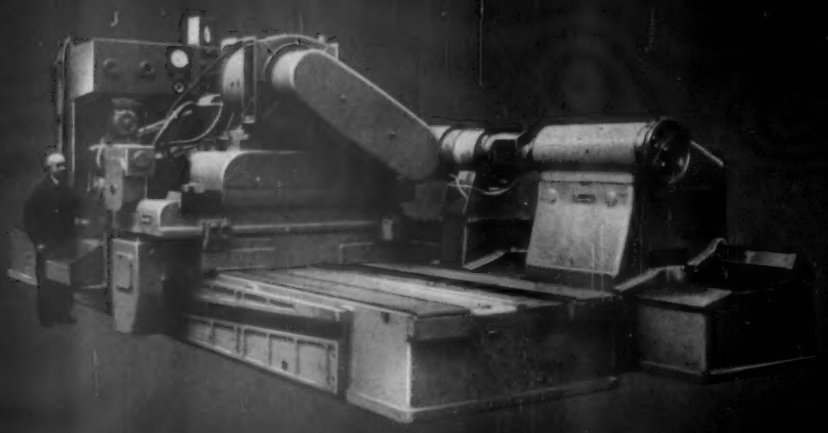
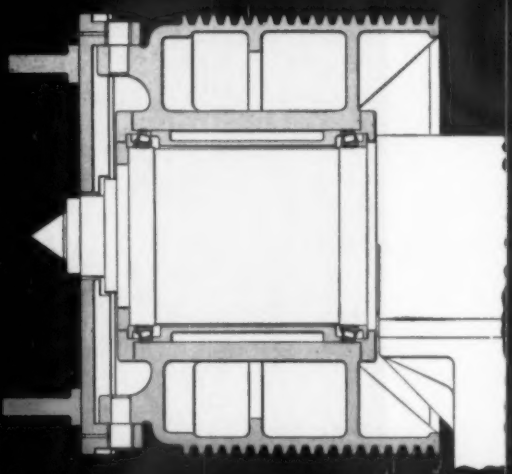




The Churchill heavy-duty roll-grinding machines

This range of machines, built by the Churchill Machine Tool Co. Ltd., Broadheath, comprises three sizes, for grinding parallel or cambered mill rolls, 32, 42 or 66-in. maximum diameters.

In view of the importance of accuracy and finish, great attention has been paid to rigidity and smoothness in operation.

The patented Churchill automatic electronic feed system ensures that maximum use is made of the power available for grinding by maintaining a constant depth of cut.

The general view shows the model T.W.B., 42-in. by 192-in., weighing 76 tons, as supplied to The Steel Company of Wales Ltd.

When on test before despatch, this machine ground 0·024-in. from a hardened forged-steel roll 20½-in. dia. by 80-in. long, in 15 min. Following this it was possible to obtain a surface finish of 1·5 to 2 micro-inches on this same roll.

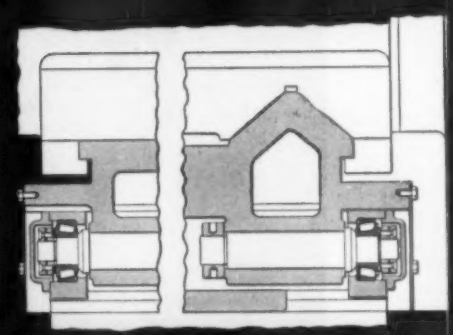
The sectional drawings show:

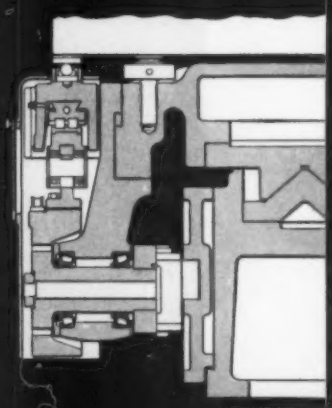
Top: The work head, of dead centre type, with the vee-belt pulley carried on light-section Timken bearings.

Centre: Timken bearings in the trunnions of the grinding wheelhead.

Below: Timken bearings in the cambering mechanism.

British Timken, Duston, Northampton, Division of The Timken Roller Bearing Company. Timken bearings manufactured in England, Australia, Brazil, Canada, France and U.S.A.





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REGISTERED TRADE-MARK

tapered roller bearings

NEW

CROFTS STATIONARY FIELD MAGNETIC INSTRUMENT CLUTCHES

Specially developed for use in the increasingly important fields of light engineering and instrumentation, they have a wide variety of applications as clutch couplings, clutch brakes and duplex clutches.

The standard range covers five sizes, transmitting torques from 4 to 420 oz./ins. at speeds up to 20,000 r.p.m.

Additionally, a range of positive engagement clutches, of similar sizes, transmits torques from 14 to 1,400 oz./ins. These are suitable for many applications where a non-slip drive is essential.

It's Crofts Instrument Clutches for rapid response every time!

Write for Publication 6013, showing typical applications, and giving operating data, technical details, and dimensions.

Crofts

REGD. TRADE MARK

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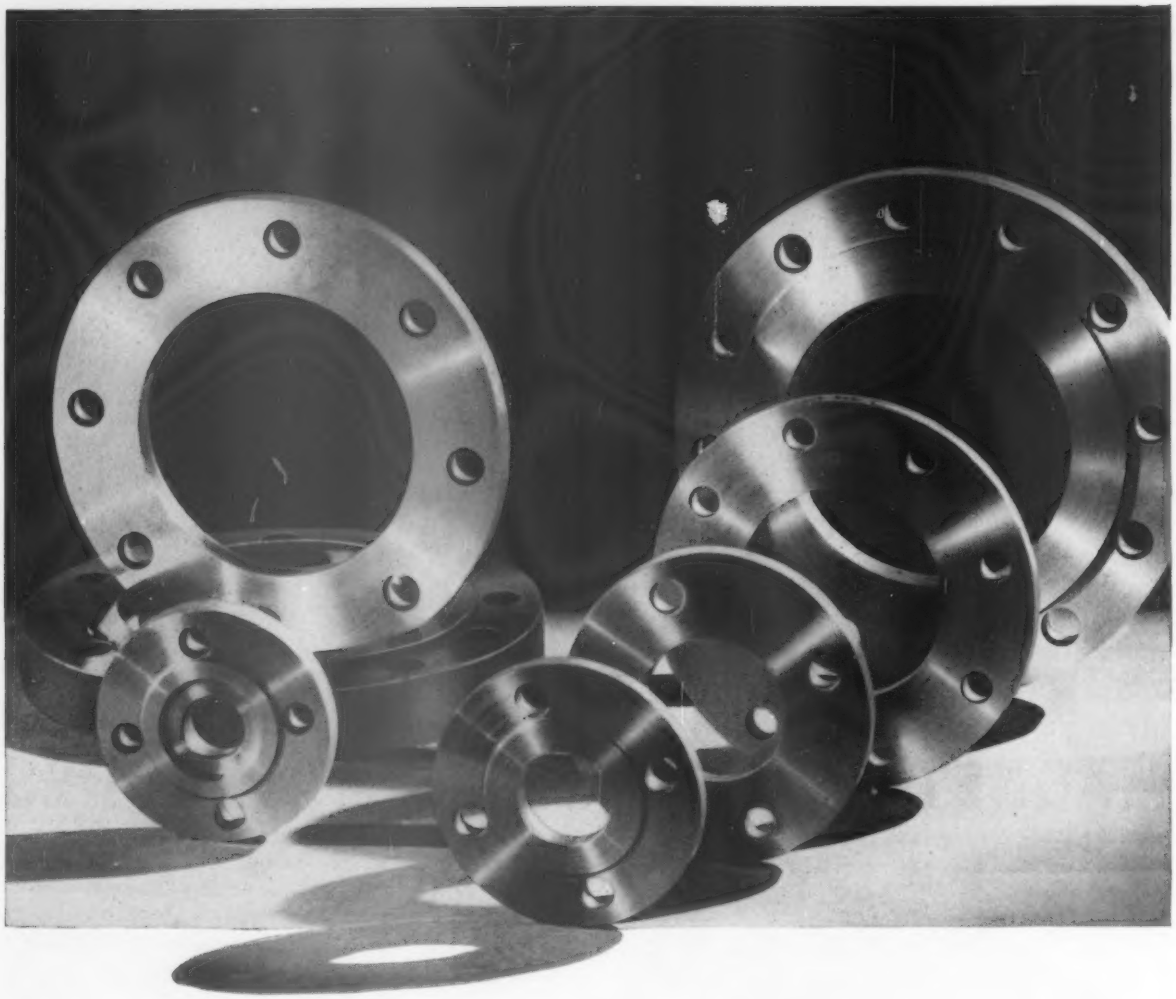

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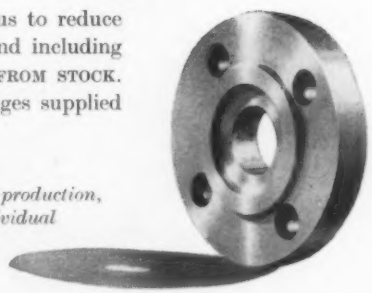
but cost is lower

New methods and improved production facilities have enabled us to reduce prices of Mild Steel Plate Type Flanges. A full range, up to and including 6″ N/B size, for pressures of 50 p.s.i. to 450 p.s.i., AVAILABLE FROM STOCK. Flanges also manufactured to customers' specification. All Flanges supplied with Rust-resistant coating. Full details available on request.

HARVEY MACHINE SHOP FACILITIES: In addition to Flange production, we have an extensive machine shop section for machining and fitting individual items or complete assemblies and machines; together with facilities for grinding (cylindrical and surface), fabrication and stress-relieving.



HARVEY MILD STEEL PLATE TYPE FLANGES

G. A. HARVEY & CO. (LONDON) LTD., WOOLWICH ROAD, LONDON, S.E.7. Telephone: GREenwich 3232 (22 lines)

E/2

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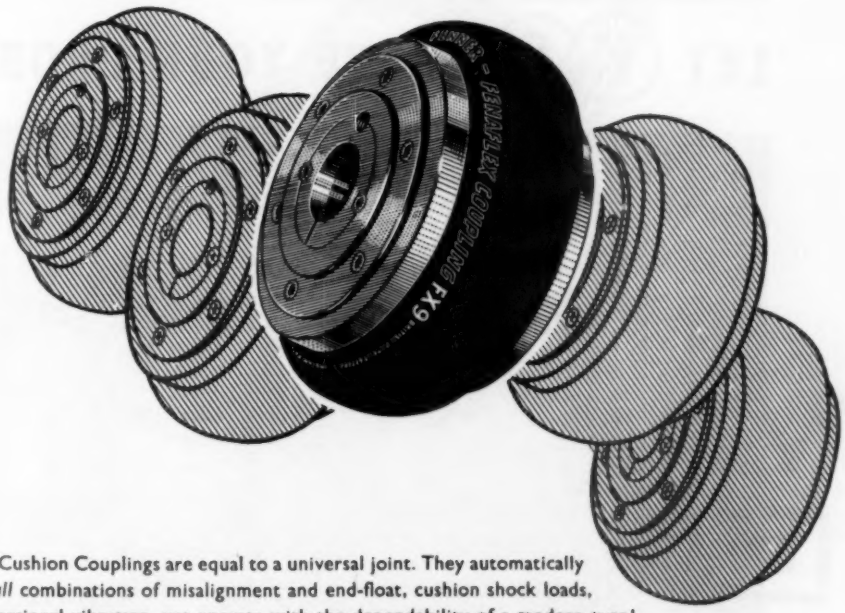
CUSHION COUPLINGS



THE RUBBER TYRE COUPLINGS WITH THE FOUR-WAY FLEX

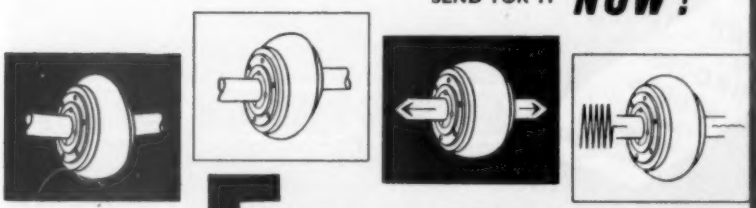
Fenaflex Cushion Couplings are equal to a universal joint. They automatically correct *all* combinations of misalignment and end-float, cushion shock loads, reduce torsional vibration, yet operate with the dependability of a modern tyre! The Fenaflex Coupling *is* a tyre with synthetic tension members bonded in rubber. Depending on the size of the coupling and the duration of shaft misplacement, it corrects angular misalignment up to 4°, parallel misalignment up to $^{1}/_{8}$ inch and end-float up to $^{5}/_{16}$ inch. There is no metal-to-metal contact, lubricating is unnecessary and there are no protruding parts.

This coupling occupies the minimum space on the shaft and Fenner standard Taper-Lock bushes make mounting quick and easy. As the flexible member is moulded with a transverse split, it can be replaced without moving the machine or the motor.

This flexible coupling with time-saving TAPER-LOCK for fixing, is available in 9 sizes, the largest taking 20 h.p. per 100 r.p.m.

Leaflet 353/18 will give you full technical information.

SEND FOR IT NOW!



Fenner

J. H. FENNER & CO. LTD · MARFLEET · HULL

Fenaflex Couplings are obtainable from stock at all 19 Fenner branches and Fenner engineers will gladly demonstrate Fenaflex to you—telephone your nearest branch.

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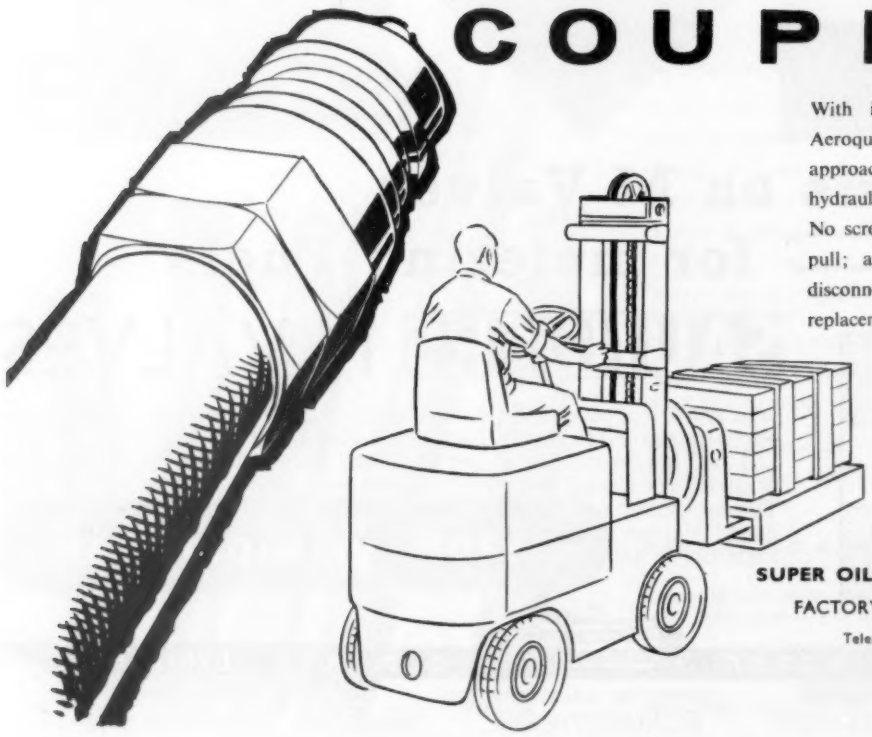
Announcing the NEW Inexpensive...

Aeroquip

'GOLDEN FLOW'

QUICK-RELEASE SELF SEALING COUPLING



With its simple quick release action, Aeroquip 'Golden Flow' brings a new approach to the method of connecting hydraulic feed lines.

No screwing or unscrewing—just push or pull; automatic sealing immediately on disconnection; and at a low initial and replacement cost.

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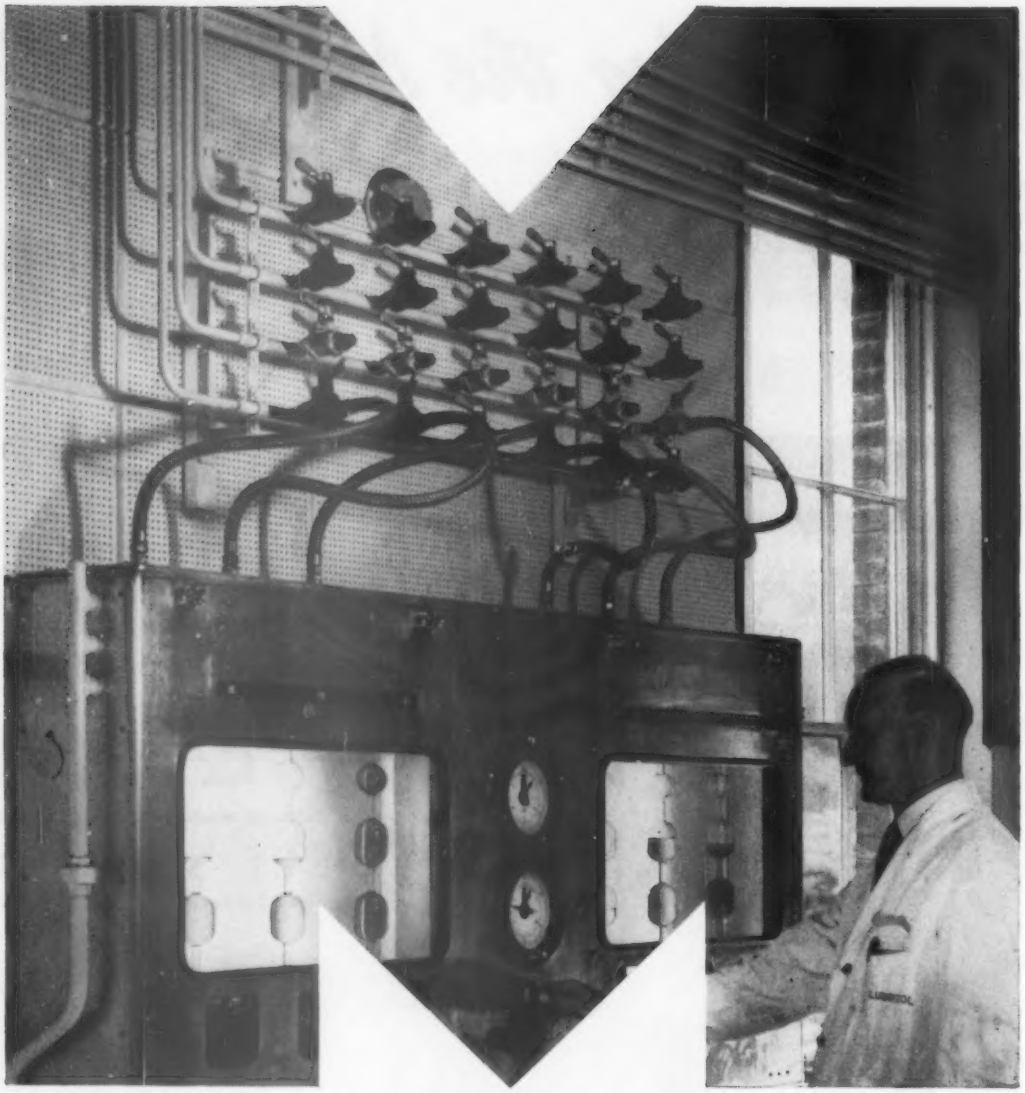
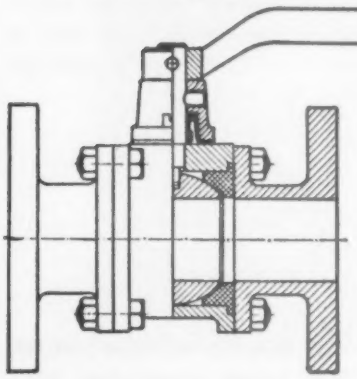
SUPER OIL SEALS & GASKETS LIMITED
FACTORY CENTRE, BIRMINGHAM, 30
Telephone: KINGS NORTON 2041



Emphasis on M Valves . . . for metering Fuels



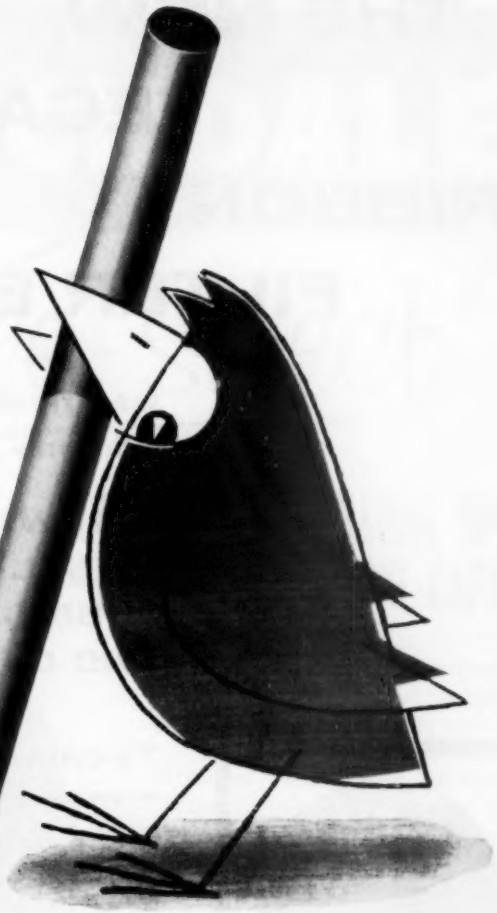
SAUNDERS M VALVES

with spherical plug and flexible sealing are mounted in batteries for each engine test rig in the Technical Laboratory of Lubrizol (Gt. Britain) Ltd., at Hazelwood, near Derby. Many types of internal combustion engines are tested with fuels treated with detergents and additives. The measurement panels with six Saunders T.P. shut off valves and 24 M Valves above have reduced leakage to nil and ensured functioning with complete accuracy.

SAUNDERS VALVE COMPANY LIMITED

DIAPHRAGM VALVE DIVISION

CWMBRAN · NEWPORT · MONMOUTHSHIRE · Telephone: CWMBRAN 3081



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Nettlefold & Moser

Nettlefold & Moser give a speedy delivery service from a wide range and extensive stocks.

These include:

'Mills' Bright Steel:
rounds, squares, hexagons, angles, flats.

'Mills' Ledloy Freecutting Bright Steel
to Spec. EN 1 A: rounds, squares, hexagons.

'Mills' Super Non-Leaded Freecutting Bright Steel
to Spec. EN 1 A: rounds, hexagons.

'Mills' Bright Steel
to EN Specifications.

Nettlefold and Moser Ltd. are main stockholding agents for Exors. of James Mills Ltd.

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NM 51

THE NEW TECALEMIT RIBBON FILTER ELEMENTS

set a fresh standard of high efficiency filtration for

AIR—WATER—PETROL, DIESEL AND FUEL OILS— LUBRICATING, HYDRAULIC AND OTHER FLUIDS

Tecalemit Ribbon Filter Elements

Simple construction—Low cost—High flow rate—Easy to clean

The elements are formed of resin impregnated cellulose ribbon, wound helically and electrically fused into an open-ended cylinder. Innumerable microscopic orifices between the ribbons allow a very high flow rate, while retaining impurities on the outside or inside surfaces, according to direction of flow.

The standard range of diameters (in any length) covers most applications, and no other filtration material can so readily be adapted to individual requirements for filters, strainers, breathers or separators. Never before has such fine filtration been possible at such low cost and with such flexibility in use.

Tecalemit Ribbon Elements filter to maximum purity

Tecalemit Air Breather Filters

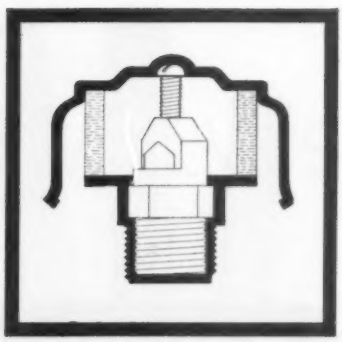
(incorporating Tecalemit Ribbon Filter Elements)

Cheapest—Most efficient—Cleanest to service

Tecalemit Breathers act as ventilators to provide a free flow of clean air to hydraulic fluid, fuel and oil reservoirs. They give positive protection from airborne contamination to tanks, pumps, valves, cylinder and other engine components.

Of the standard types, two are breathers with screwed bodies, and the third is a combined clip-on assembly of breather and filter cap. All are fitted with Tecalemit Ribbon Filter Elements.

Tecalemit Breathers provide pure air cheaply and efficiently



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the authority on filtration

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"Pre-select"

FOR GREATER OPERATING SPEEDS —FASTER PENETRATING CAPACITY

Shown in use at The Electric Construction Co. Ltd., Wolverhampton, this ARCHDALE mechanical 'Pre-select' is fully meeting our claims to cut production times to a minimum. Not only are penetration rates as high as power and rigidity can make them, but much valuable time is saved by convenient pre-selection from 16 spindle speeds, at any time, whether the spindle is running or stationary. Spindle speeds range between 15 and 1,500 r.p.m., and the six rates of feed, selected by a single lever, between 24 and 400 r.p.i.

N.B.—The illustration shows the drilling and spot facing of main fixing holes in end brackets for 250 b.h.p. electric motors.

INTERNATIONAL MACHINE TOOL EXHIBITION LONDON 1960 OLYMPIA JUNE 25-JULY 8

STAND No. 50

JAMES ARCHDALE & CO. LTD.

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POWER TRANSMISSION ACCESSORIES

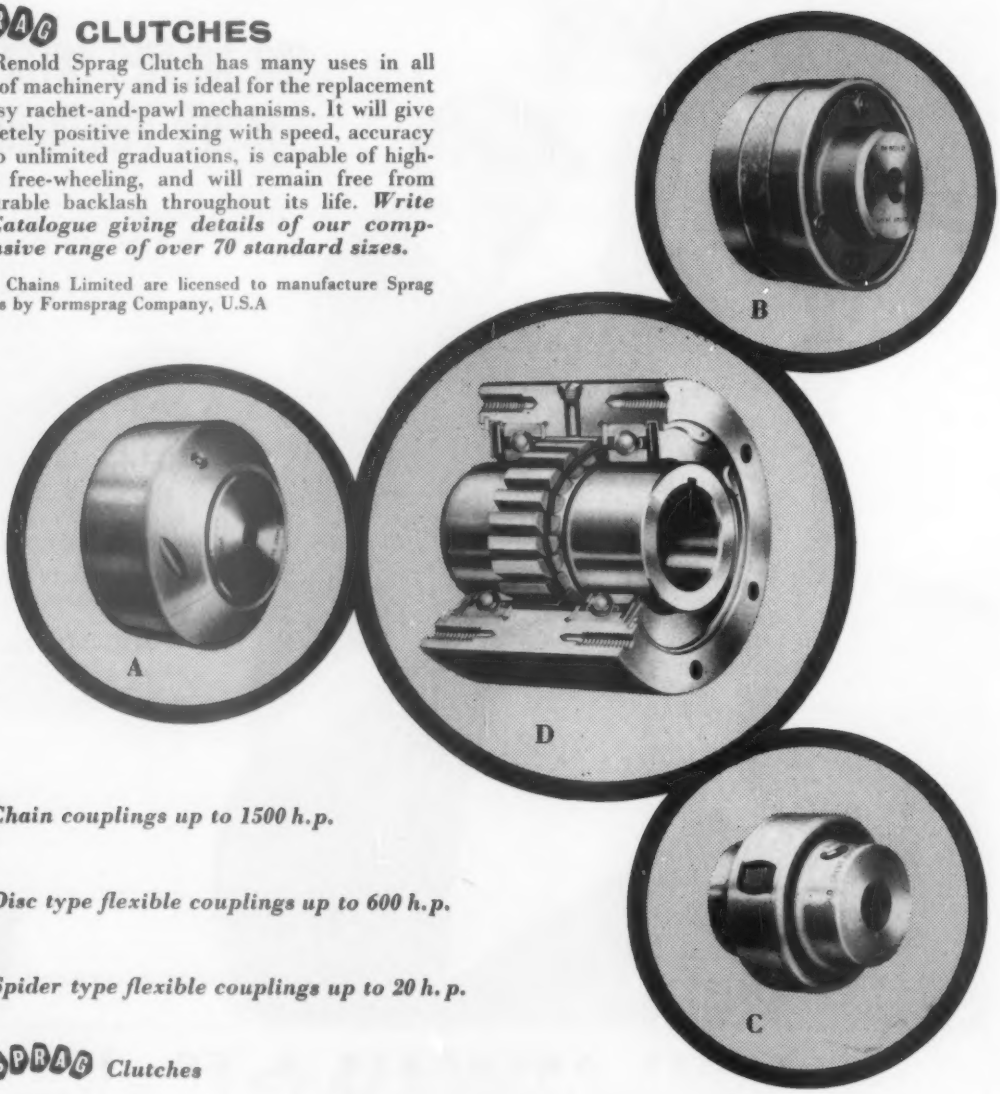
COUPLINGS

Sturdy and compact, Renold Couplings have for many years proved their value on a wide variety of applications—and they are AVAILABLE FROM STOCK. ***For complete information ask for Catalogue Ref. 116/110***

SPRAG CLUTCHES

The Renold Sprag Clutch has many uses in all types of machinery and is ideal for the replacement of noisy rachet-and-pawl mechanisms. It will give completely positive indexing with speed, accuracy and to unlimited graduations, is capable of high-speed free-wheeling, and will remain free from measurable backlash throughout its life. ***Write for Catalogue giving details of our comprehensive range of over 70 standard sizes.***

Renold Chains Limited are licensed to manufacture Sprag Clutches by Formsprag Company, U.S.A



A *Chain couplings up to 1500 h.p.*

B *Disc type flexible couplings up to 600 h.p.*

C *Spider type flexible couplings up to 20 h.p.*

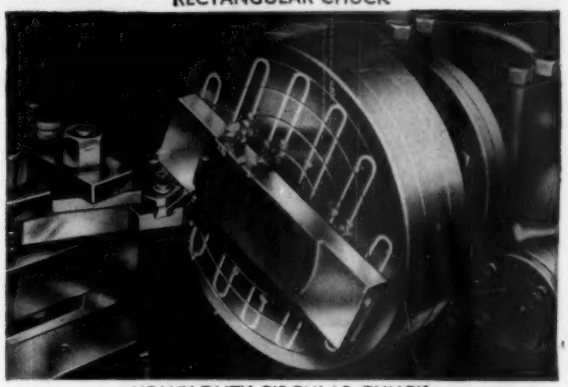
D SPRAG *Clutches*

RENOLD **RENOLD CHAINS LIMITED · MANCHESTER**

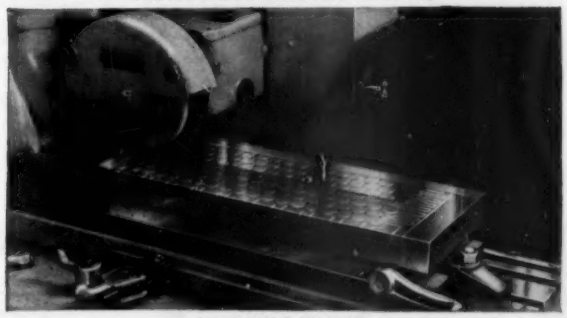
Eclipse

offers the most complete magnetic work holding service

RECTANGULAR CHUCK



HEAVY DUTY CIRCULAR CHUCK



FINE POLE CHUCK

MINOR CHUCK

MAGNETIC VEE BLOCK

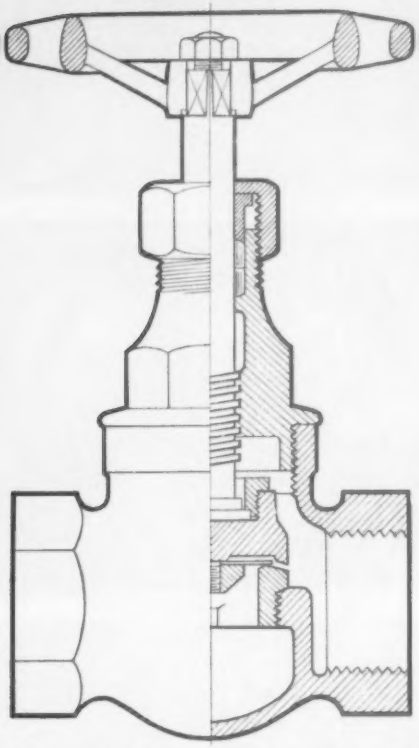
SMALL TOOLMAKERS CHUCK
MOUNTED ON SWIVELLING BRACKET

Ask for detailed literature

Made by James Neill & Co. (Sheffield) Ltd. and available through your usual 'Eclipse' dealer

PM 156

News from Hattersley



the Fig. 2016 'PRESEATOR' globe valve with the Flexible Titanium Disk*

This specially designed Hattersley valve incorporates a flexible pre-seating disk made of an I.C.I. titanium alloy which is exceptionally resistant to corrosion and erosion. As this seats before the main surfaces, pipe-scale is trapped and the main seating surfaces protected from the effects of wire drawing.

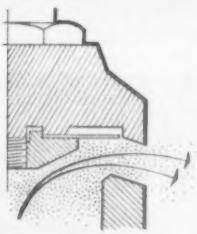
The broad-faced clack and its seat are of differing compositions of nickel alloy, giving differential surface hardness which prevents galling and seizure. There are many other fine features in this new design valve.

Suitable for steam at 200 lb. per sq. in. and 500° F.

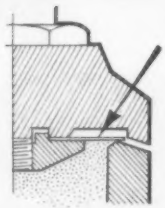
Please write for literature.

* *The Flexible Titanium Disk is protected by Patent No. 822147*

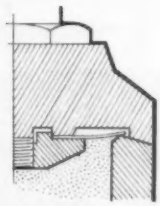
Over a period of years the outstanding merits of this Valve have been proved under the most arduous service conditions on many installations.



In open position free passage for flow directed across seating surfaces.



In 'Pre-shut' position flow and pipe scale held back by *Flexible Titanium Disk*. Patent No. 822147



Valve fully closed. Seating surfaces have passed through wire-drawing zone under virtually 'no-flow' conditions.

HATTERSLEY ESTABLISHED 1897

the name for good valves

HATTERSLEY (ORMSKIRK) LIMITED · ORMSKIRK · LANCASHIRE
and at HALIFAX and LONDON

H.2

TECALEMIT MECHANICAL LUBRICATION —THE BLOOD-STREAM OF A MACHINE

Tecalemit Mechanical Lubrication Systems save power, lubricant and labour, and greatly increase the working life of your machines. They are infinitely flexible, and can be fitted into new designs or existing machinery.

With Tecalemit Mechanical Lubrication, bearings need no longer be accessible to hand oiling, and there will be no forgotten, neglected or under-oiled bearings to cause costly breakdowns and production hold-ups. Nor is there any danger of messy excess lubricant spoiling products. Tecalemit Mechanical Lubrication Systems provide accurately regulated lubrication to each individual bearing, at the correct intervals.

The BRENTFORD is a fully automatic multiline oiling system, with from one to twenty lines, each with its own independently regulated pump. The unit takes its power from the rotary or reciprocating motion of the machine it serves, or can be supplied with its own electric motor.

The BIJUR is a single-line system, with one central pump supplying up to 100 points. Each outlet is equipped with a metering valve which gives a pre-determined regulated supply of oil to each bearing.

Tecalemit Mechanical Lubrication can solve your problems and speed your production.

TECALEMIT

To TECALEMIT LTD. (Sales MEW), PLYMOUTH, DEVON

Fill in this coupon and post it today. If you have a particular application or trouble-spot in mind, by all means enclose a note, a sketch or a drawing. You will be under no obligation whatsoever.

Please send me full information on:—

- Tecalemit BRENTFORD Mechanical Lubrication ☐
- The Tecalemit BIJUR Single Line System ☐
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- I enclose details of a particular lubrication problem ☐

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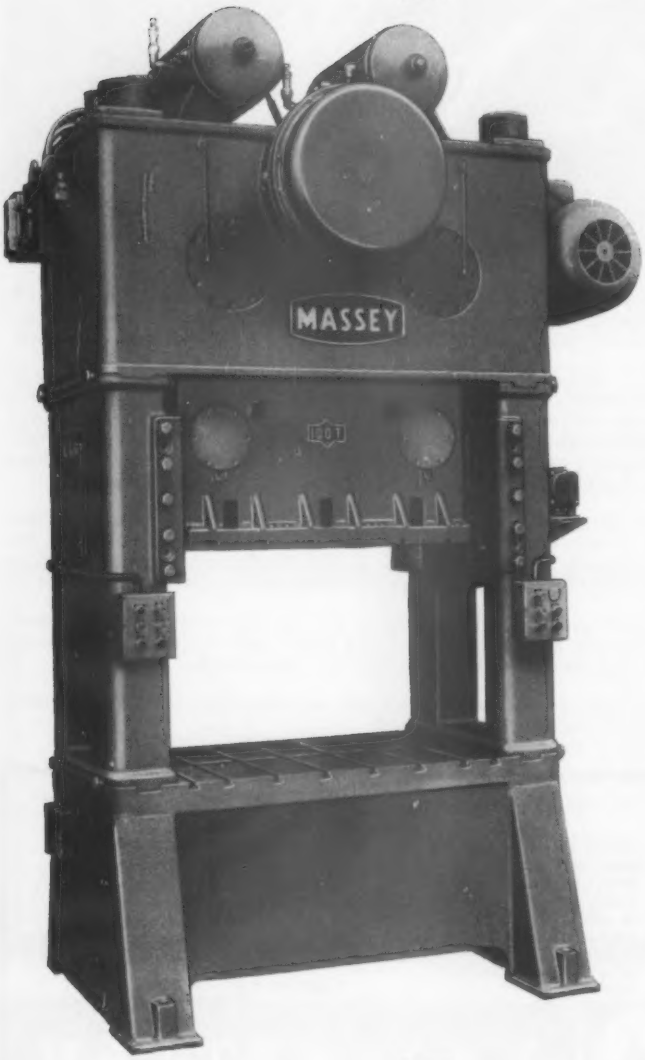
MASSEY

WIDE RAM PRESSES for trimming, setting etc.



Available in sizes from 100 to 1,000 ton, this specially designed multi-purpose press enables pre-forming, setting and straightening to be carried out in addition to trimming and piercing operations. Electrically driven, with transmission through alloy steel double helical gears. Comprehensive lubrication system automatically interlocked with main press drive. Frame of maximum strength with large diameter tie bolts shrunk into position. Air-operated friction clutch fully protected against overload.

STAND 26, GRAND HALL, INTERNATIONAL MACHINE TOOL EXHIBITION, OLYMPIA, JUNE 25th — JULY 8th, 1960

100 Ton Wide Ram Trimming and Setting Press.

MASSEY DESIGNS INCLUDE

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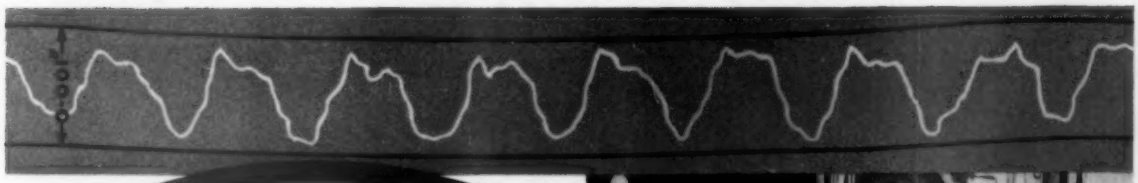

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The diagram shows a composite-error record (in part) of a precision-hobbed 4 D.P. spur ring of 56.250-in. P.C.D. Photograph shows gear ring on hobbing machine after cutting, with master gear spring-loaded in close mesh, and error record being taken. *Total error over 225 teeth—including master gear error—0.0012 in.*

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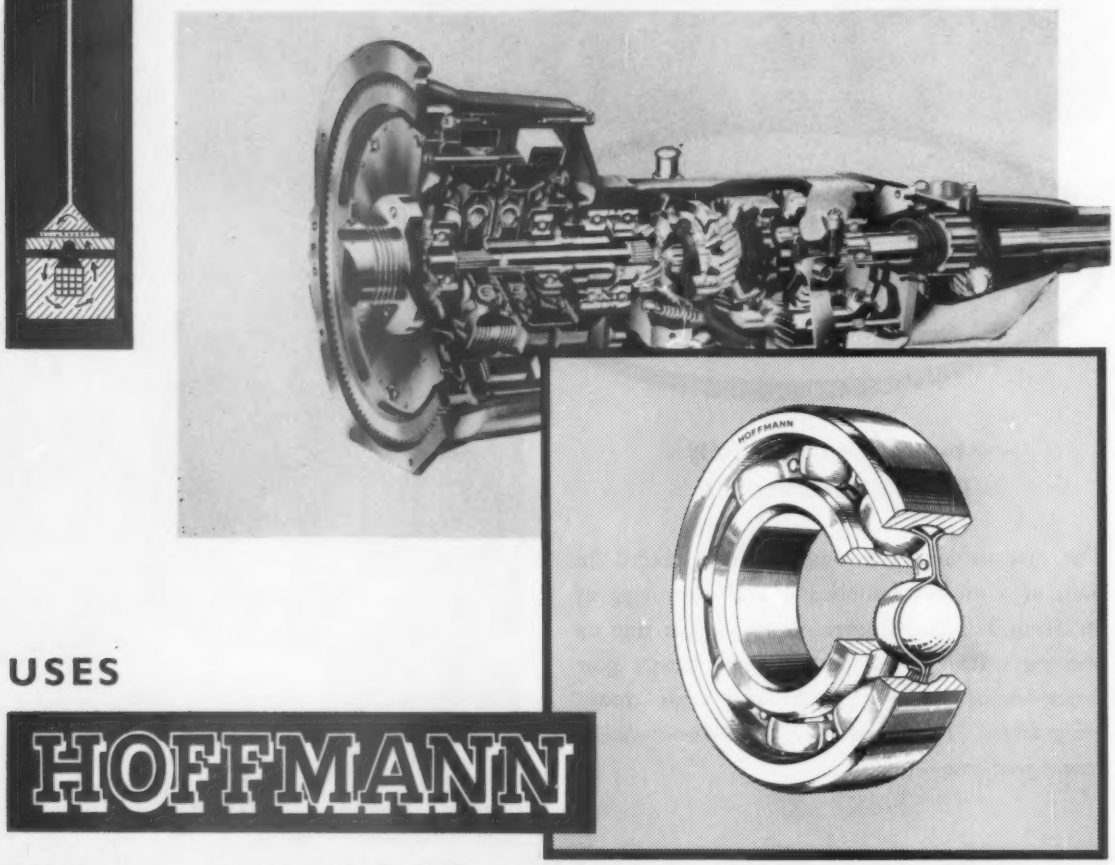

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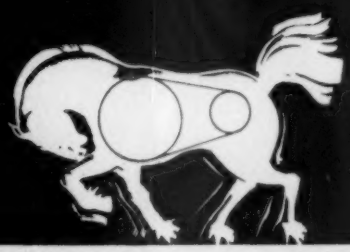

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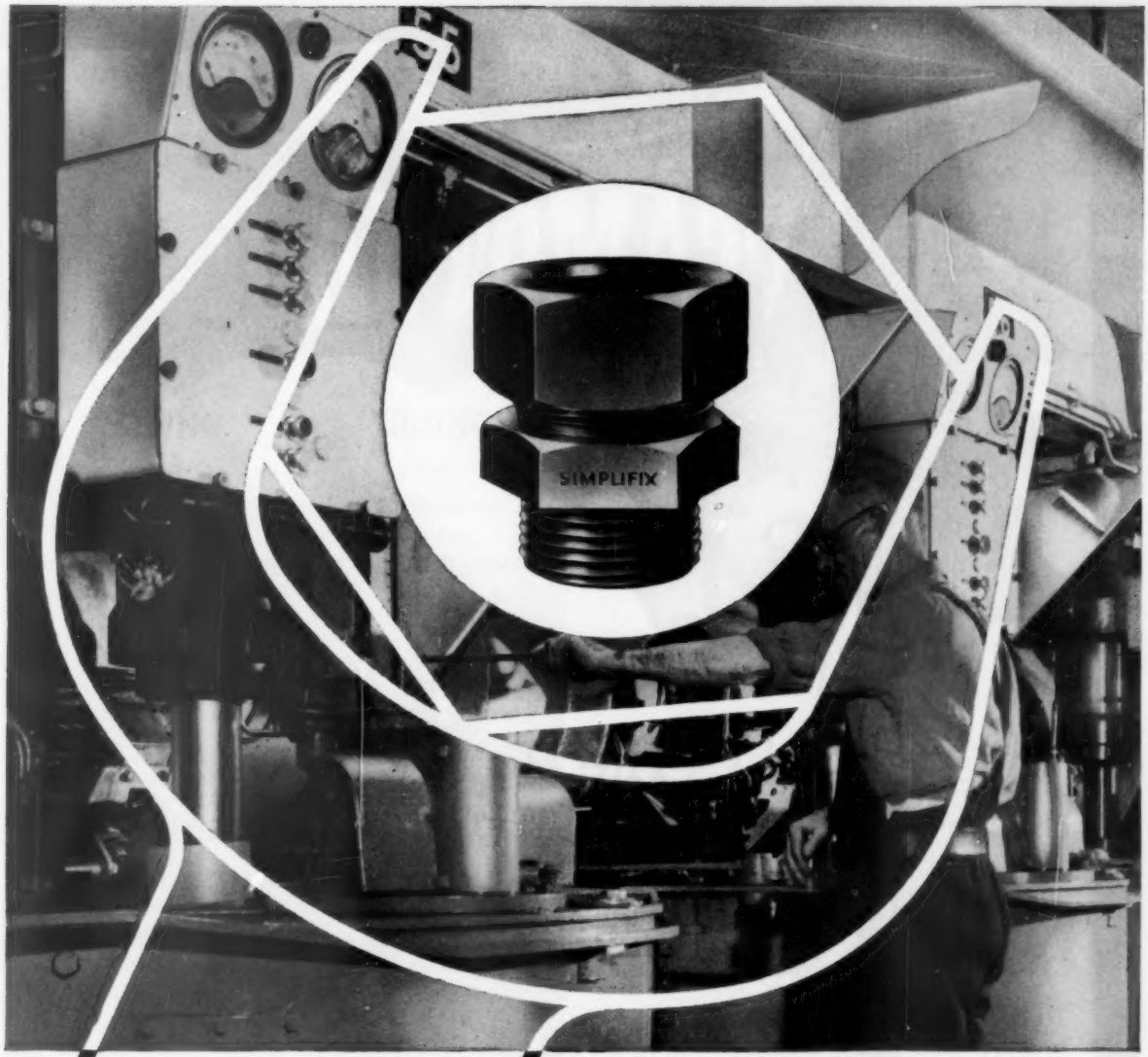

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The illustration shows centrifugal machines at the Plaistow Wharf Sugar Refinery of Tate and Lyle Ltd., where large numbers of Simplifix couplings are used.

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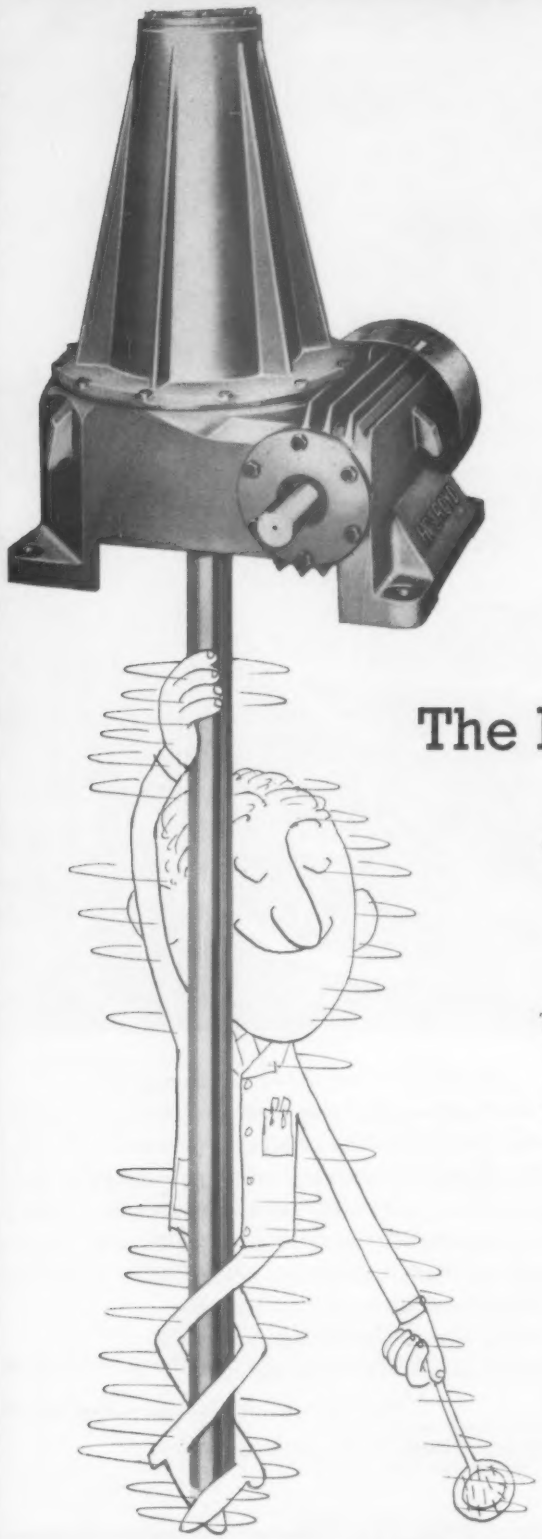

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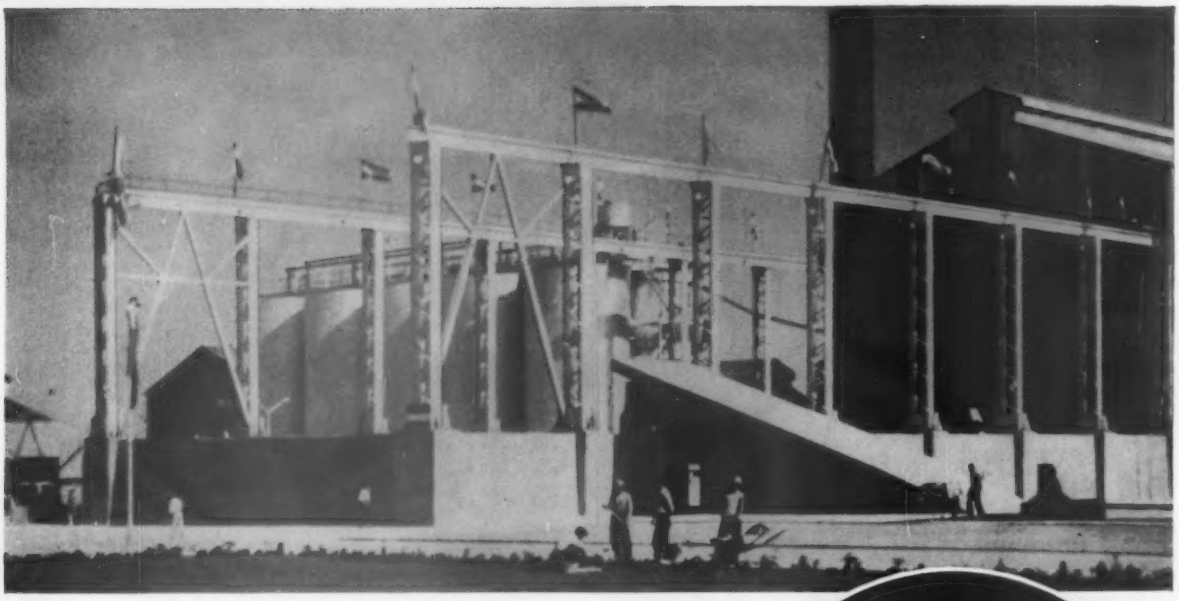
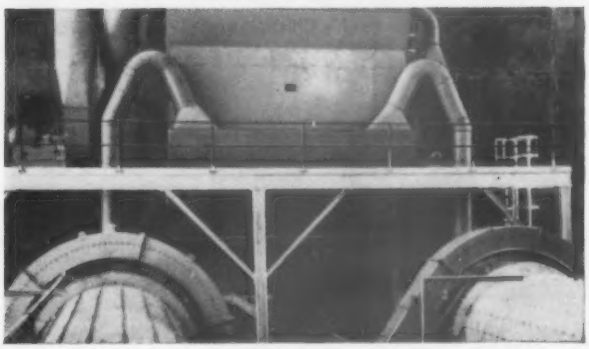


New Cement Works in Iran

MECHANICAL PLANT manufactured and erected by EDGAR ALLEN & CO. LIMITED



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Mechanical World

AND ENGINEERING RECORD

Vol. 140 JULY, 1960 Number 3492

Contents

MECHANICAL WORLD AND ENGINEERING RECORD is published monthly in Manchester and London.
MANCHESTER: 31 King Street West, 3.
Telephone: BLAckfriars 7086.
Telegrams: Textile, Manchester.
LONDON: 158 Temple Chambers, Temple Avenue, EC4.
Telephone: FLEet Street, 8914.

Subscriptions. The annual subscription rate throughout the world is 30/- post free. Subscription orders may be sent to the publishers at either of the addresses given above, or placed through any newsagent or subscription agency. The price of single copies is 2/6 (3/3 by post).

Advertising. Communications and inquiries should be addressed to the Advertisement Manager at the Manchester address given above.

Remittances should be made payable to the publishers, Emmott & Co. Limited, and crossed "Midland Bank Limited"

Contributions. The Editor invites original contributions on mechanical subjects. Broadly the aspects covered are the design, materials, manufacture, process, management and maintenance of engineering and industrial plant and machinery. Sketches should be in black ink if possible but the lettering may be left in pencil. Photographs are welcome and so are short notes of practical experience. Payment is made for exclusive contributions. Communications should be addressed: The Editor, MECHANICAL WORLD, 31 King Street West, Manchester 3.

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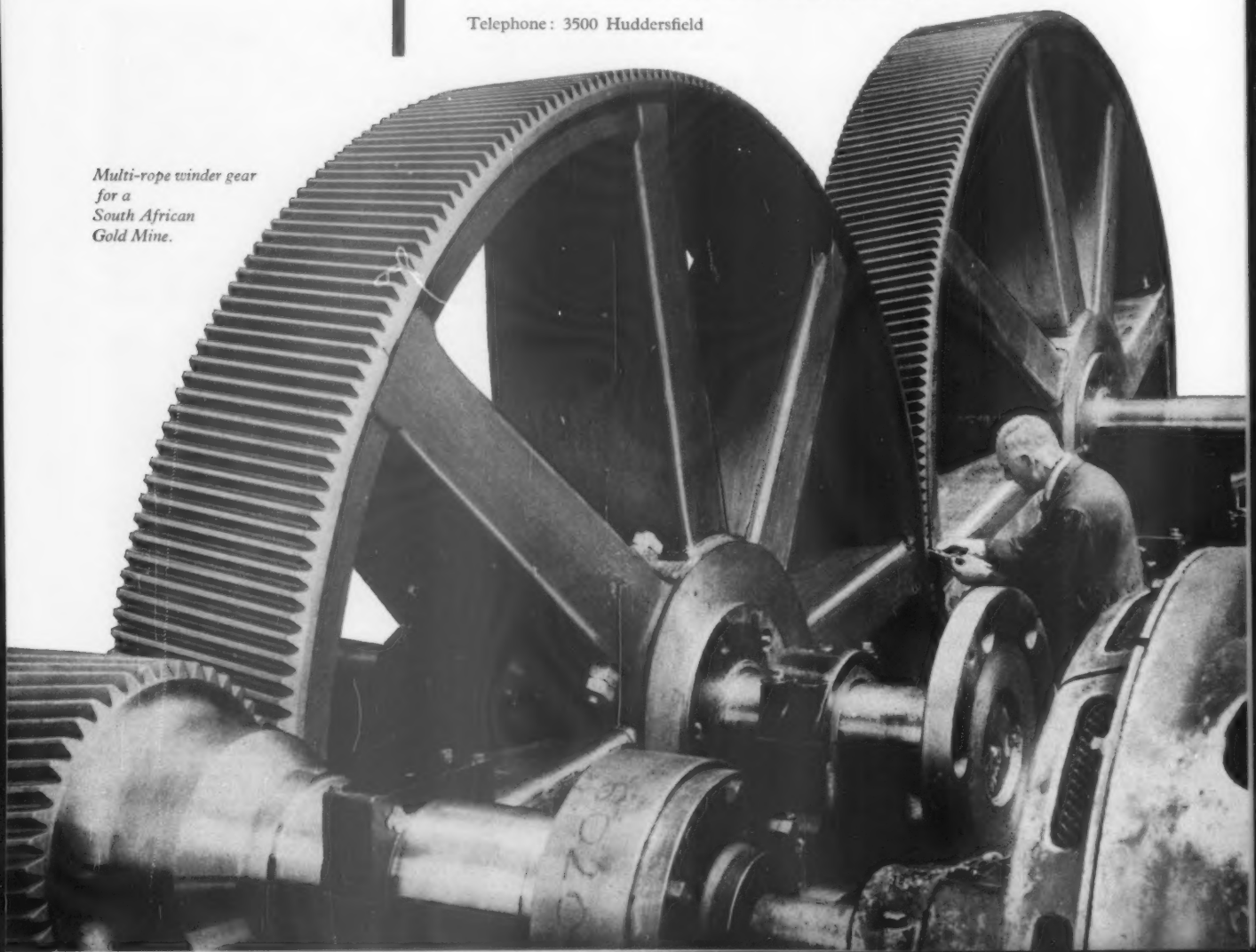


Multi-rope winder gear for a South African Gold Mine.

Mechanical World — July 1960

Time for Research

THE circumstances accompanying the problems that arise out of industrial experience do not always contain an indication of either the nature or the usefulness of the solutions. Occasionally the road is clear and then there is no hesitation about what to do: this is the usual course of everyday industrial development in product design, manufacturing improvement and a good deal of invention. For the most part, however, the haze of the unknown obscures the view and exploratory research is required before even the field can be mapped and the likelihood of usefulness appreciated. There can never, therefore, be intelligent objection to exploratory research—long-term research as it is called—for without it the knowledge of where to look next waits upon accident, and the ordering of work is customarily arranged to avoid that. Knowing something of the field one can perceive where useful results are to be found and how near or far away they are from practical application. The researcher knows all this very well, and he knows too that for industrial purposes he needs objectives if his work is to be translated into terms of industrial utility. Objectives are defined by the problems encountered in industry. It follows from this that the problem must be taken to the research field, and it is this that is at the root of all arguments for co-operation between industry and research. Recently the National Engineering Laboratory has drawn attention to the priority which it gives to immediate industrial problems while at the same time spending a proportion of its endeavour on research of a longer term nature, but always with practical objectives in view. In their report the Steering Committee have also said that in determining the programme they have had to make some hard decisions. This is evidence enough that the laboratory is aware of a field for potential research which is not matched by its resources. It is just a question whether resources ever could match up with research possibilities; after all, knowledge appears to be illimitable whereas human resources are determined by acquired capacity. It is equally true that time goes by and that in human terms there is none to be lost.

LOG SHEET

Wheel Profile Truing

The installation of a new wheel profile truing machine in the Eastern Region Locomotive Works at Stratford, London E. has greatly reduced the time required to maintain the increasing number of diesel and diesel electric locomotives now in service in the region, and has lengthened the service life of the wheels.

Truing the wheels, that is, restoring the original contour to the flange, tread and rim—formerly necessitated the stripping of components such as wheel assemblies, brake rigging and traction drive mechanisms—a time consuming operation. Wheels are now treated at this depot without the necessity for dismantling, and as a result, the tyres of a main line six-axle diesel-electric locomotive can be re-profiled in four to six hours, according to the amount of wear.

The distinctive feature of the new machine is the re-cutting of the tyre profiles by a milling process, instead of the single point turning method. Housed in a pit below the rails, the machine is operated from a control panel at rail level. Vehicles are moved into position over the cutters and on to a retractable section of track. The wheels are correctly positioned by applying machine centres to axle centres, and when the driving rollers are raised against the wheels to be machined, the track section is hydraulically retracted. After starting the wheel driving rollers, the depth of cut is adjusted and one revolution of the wheels normally restores the contour of the tread and flanges simultaneously.

Manufactured for the Atlas Engineering Company, London SW7, by the North British Locomotive Company Limited, the machines were originated and patented by the Standard Railway Equipment & Manufacturing Company of Chicago.

Oil Blending

Fisher Governor Company Limited, a member of the Elliott-Automation Group, has completed the commissioning of four large in-line fuel oil blending units for the Mobiloil Company at their new ocean terminal at Ellesmere Port, Cheshire. The installation enables varying grades of fuel oil to be supplied to loading arms for road and rail tankers and maintains the specification of the oil to within ± 1% of the desired viscosity, an accuracy which has not previously been achieved by commercial distributing installations in this country.

The design of the blending units uses the principle of parallel metering of two fluid components and the establishment of equal pressures at the point of metering, a method which achieves a high accuracy of blend without the need of an external source of operating power.

As an exceptional degree of accuracy in the blend at an unusually high rate of flow was required, a modified design of its standard blending unit with 10 in. and 6 in. heavy and light oil component arms respectively, with a 12 in. dia outlet was developed and a mechanical mixer was installed. To achieve the additional accuracy of blend it was decided to fit to each of the blending units a Smiths viscosity control unit, to make the installation self-compensating for changes in the viscosity of the component fuels. Each unit of the Ellesmere Port installation is now capable of blending oils to produce viscosities of 200 to 1500 sec Redwood No. 1 in proportions of 97:3 to 60:40 and at flow rates ranging from 0–1400 I.G.P.M. to within the overall accuracy called for of ± 1% of the desired viscosity value.

Two arms of one of the four Fisher blending units installed at Mobiloil's ocean terminal at Ellesmere Port, Cheshire, showing the electrically operated metering valve in the light component line

A general view of the control building showing the delivery end of the Fisher blending units protruding through the walls of the building

Making Money

The Royal Mint is installing a large amount of Sherwen electro-magnetic vibrating equipment on some of the machines used in the manufacture of coins for countries in all parts of the world. This equipment, designed and manufactured at the Erith Engineering Works of The General Electric Company Limited, reduces the manual labour necessary in some of the operations involved. With the latest order, the total electromagnetic vibrating equipment now on order or supplied comprises 18 — 9 in. × 14 in. and 14 — 3½ in. × 17 in. Sherwen feeders, and 14 — 12 in. dia Sherwen bowl-type feeders.

To appreciate the part played by the vibrating units, it is necessary to indicate briefly, the nature of the minting process.

The metal is received by the Royal Mint in its virgin state, either in the form of ingots (copper, tin, zinc, manganese and phosphorous copper) or in 5 cwt drums (nickel shot). If required, silver and gold would be received in ingot form.

After reception it is prepared in charges for the furnaces—in the correct proportions required for the type of money to be minted. There are four oil-fired and five high-frequency furnaces. The maximum temperature attained by the furnaces is 1380° C, this being necessary for cupro-nickel, the alloy most commonly used for present-day coinage.

The charge, which varies in weight depending on the alloy, is set at between 800 and 850 lb for cupro-nickel. This, when molten, is poured from the furnaces into moulds to make bars of approximately 26 in. × 4 in. × 1 in. thick. These are then

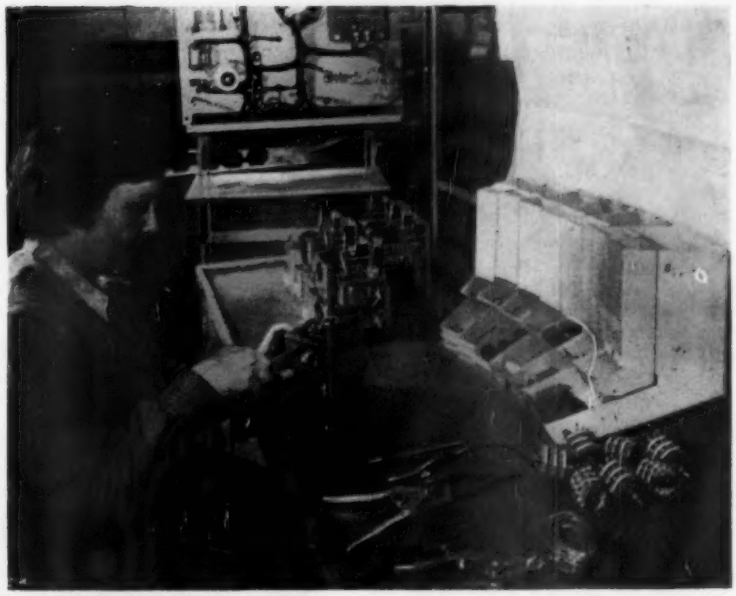
passed through several rolling mills and a final gauging mill which reduces the alloy to its right thickness. Due to the work-hardening effect caused by the rolling operations, annealing of the alloy is introduced at appropriate stages. The strips are next cut to the most economical length relative to the coin to be produced, and passed to the presses where the coin blanks are stamped out. A rough sorting, to eliminate imperfectly formed blanks, is then made on a sieve type of table.

Annealing of the coin blanks is followed by blanching in sulphuric acid followed by a solution of soda bichromate. The acid is removed by water washing, and the blanks passed through rotary air driers. After this operation they are transported to the canneluring room where the edge of each blank is compressed to form a raised rim. From here the blanks are passed to conveyors where visual inspection of both faces is carried out. It is at this point that some of the vibrating equipment supplied by G.E.C. plays an important part. In the past these conveyors have been fed manually, the coin blanks being emptied from bags on to ramps and directed on to the belt by hand. The ramps on all these conveyors have been replaced by hoppers and Sherwen feeders providing an automatic feed.

If beading of the coins is required it is performed at this juncture, but otherwise the blanks pass to the press room where the imprint on both faces and the milled edge (if required) is completed in one operation. There are 53 presses performing this function and in the past the coins were placed in the feed tube by the operator. A changeover is now in process in which Sherwen bowl-type feeders are being fitted to the machines to enable the operator to give his undivided attention to the striking of the coins. So far ten presses have been converted to automatic coin feed while another four are in the process of being changed over.

With the G.E.C. feeder a bag of blanks can be poured into the bowl, these then being vibrated up the spiral which is fitted on the interior of the casing, and passed down into the coin-feeding cylinder. Each bowl is fitted with an electromagnetic vibrator rated at 0·375 kVA, 230 V, and the motion is transmitted to the bowl through 16 mild steel flat springs.

The final operations in minting consist of weighing, overlooking and telling the finished product. Sherwen vibrating feeders are also fitted to these overlooking tables while Sherwen vibrators assist in the handling of the coins in the telling room.



UNIT DESIGN SIMPLIFIES MANUFACTURE.—Present day trends in designing electronic apparatus are towards making it possible to produce equipment in unit form. This of course simplifies manufacture as equipment can be built up of small units which are interconnected during final assembly or are arranged on a plug and socket principle as illustrated in this photograph taken in the New Parks Works, Leicester, of the A.E.I. Electronic Apparatus Division. An operator is shown wiring up units for Type FW.43.L-17 Thyratron welder control equipments, this type of control being suitable for use with spot or projection welding machines having a maximum welding load of up to 45 kVA

Smelters' Bicentenary

This is the bicentenary year of The Sheffield Smelting Company Limited, founded in 1760 by John Read who had set up in business in Sheffield as a refiner and became the first person there able to recover value from manufacturers' silver scrap. By 1782 Read had started smelting and leased a 40 acre site near Royds Cornmill between Sheffield and Attercliffe.

The business expanded rapidly and the Victorian era saw many improvements in smelting and refining processes, including the installation of a plant for recovering solids from furnace gases. Later the company was to install the first plant in England for the refining of silver by electrolysis. The welfare of the workpeople was not ignored and in 1865 a bonus scheme was started; by 1890 a 48-hr week was introduced and by 1894 a bath-house and dining rooms were provided; holidays with pay were granted in 1900.

At the end of the 1914-1918 War there were further extensions to plant and buildings and then in the 1930's under the present chairman, Robert Jardine, the company broadened its basis of trade and entered the light engineering and electrical and allied trades fields. The 1939-1945 War saw many changes in home market requirements, and Government supply departments, Royal Ordnance factories and munitions producers were the main clients.

Today the traditional activities have been greatly expanded and new ones added, including the production of non-ferrous ingots. Its products go all over the world and from humble beginnings the company has grown into one of the largest organizations of its kind.

Pressed Steel at Jarrow

The new Pressed Steel plant in the Jarrow/South Shields area will represent the company's first interest in the North-East Coast—and, indeed, probably the first venture by the motor industry into that area. It will take the form in the first place of a 100,000 sq ft factory built in conjunction with the Board of Trade on 26 acres of land on the Simonside Trading Estate. The factory will be devoted entirely to the production of specialized press tools—a further addition to the company's already vast capacity in this field, which is

believed to be among the largest in Europe, and possibly in the world. It is anticipated that the factory will later be extended by a further 100,000 sq ft.

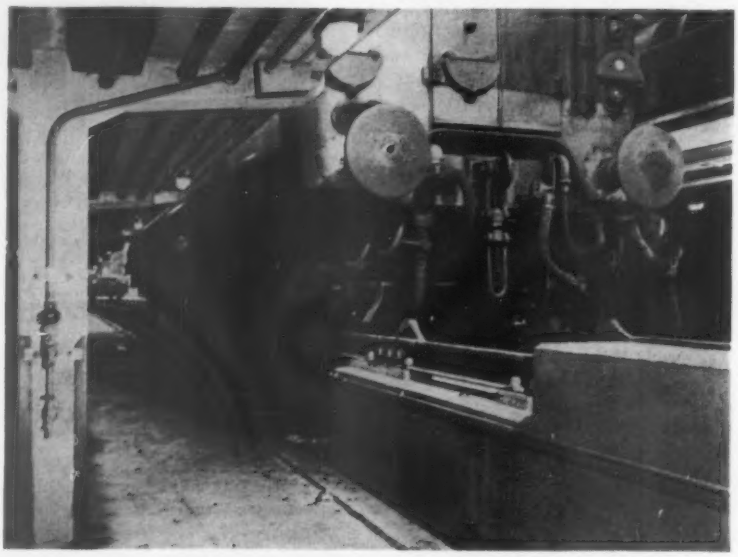
The manufacture of press tools of this kind is a major part of Pressed Steel's activities and many of the tools when completed may weigh upwards of 40 ton. They must, however, be machined with the greatest accuracy and one set of dies may involve hundreds or even thousands of man-hours by highly skilled craftsmen. As pressing techniques develop and higher degrees of automation are introduced, the design and construction of such dies become even more complex. The company already has large machine shops for the production of press tools at Cowley; at Linwood, where the machine shop has recently been greatly extended; and at Swindon, where a second machine shop which doubles the plant's toolmaking capacity is now in the last stages of construction.

Electronic Shopping

A new system of automatic warehousing which can be applied to supermarkets will eliminate much of the tedium from this form of shopping. The customer simply collects a number of cards, has these punched in slots beside the items selected, and brings the completed cards to the cashier who puts them in a machine which totals the prices. The customer pays, the cashier presses a button and, fifteen seconds later, the goods arrive.

The Gumertz system has been in satisfactory full-time operation for two years in America. Now a new British company, Solartron-John Brown Automation Limited, 20 Eastbourne Terrace, Paddington, London W2, jointly owned by the Solartron Electronic Group Limited and John Brown and Company Limited, has acquired the sole rights outside America for manufacture and world distribution. With the Gumertz system the warehouse is fitted with steeply slanting shelves, each carrying a layer of one "line". A barrier allows a single or any required number of articles to drop into an endless belt. The order for goods is placed in the electronic system where it is automatically read. The signals for the various lines are electronically produced and recorded into a memory drum. When the order has been "collected" the memory is fed into the computer system which actuates the barriers in sequence, starting with those farthest away from the delivery point. All the articles arrive together and a hundred or more lines can be delivered in about fifteen seconds. Shortages can be signalled and the system provides amended data for automatic pre-invoicing or advice note delivery.

Economic justification for the Gumertz system starts at 1000 orders per day and it would be economically applicable to supermarkets with £200,000 per annum turnover.



Low level repair bay at Finsbury Park diesel maintenance depot

Diesel Loco Maintenance

A new £300,000 railway depot—the first in Britain to be built specially for the maintenance of diesel main line locomotives—has been brought into use at Finsbury Park by the Eastern Region of British Railways. When working to full capacity, it will maintain no fewer than 152 diesel locomotives and 31 shunters—ranging from 350 hp to the 3300 hp Deltic main line locomotives.

The main shed is a steel-framed structure, having a single span of 111 ft 6 in. and being 18 ft 6 in. from rail level to the eaves. The roof covering is double-skinned asbestos cement with glass fibre insulation and continuous glazing and the sides consist of dwarf brick walls. The whole structure is carried on piles of which there are approximately 400. The shed contains six tracks, each holding three locomotives, the rails being supported on short tubular columns. This arrangement, in conjunction with permanent working platforms at footplate level enables the maintenance work to be carried out with the maximum ease and efficiency.

A two-storied building at the south end of the shed accommodates the workshops, offices, stores and staff amenities. The boiler house of brick construction has a steel-framed clerestory and the 55 ft chimney is of reinforced concrete construction. The design was carried out under the general direction of Mr. A. K. Terris, B.Sc., M.I.C.E., Chief Civil Engineer, Eastern Region, Mr. H. H. Powell, B.Arch., F.R.I.B.A., Architect, Eastern Region, being specifically responsible for the design of all buildings other than the actual maintenance depot. The piling was undertaken by Holmpress Piles Limited, of Barnsley Street, Hull; the steelwork fabricated by Wright Anderson & Co. Limited, Gateshead, and the general construction work by Wimpey & Co. Limited, of Hammersmith.

Electric Smelting "On Approval"

Over £50,000 has been invested by Birlec-Efco (Melting) Limited, Aldridge, in a scheme that will assist rapidly developing countries to exploit their mineral resources. The chief advantage of the scheme is that firms contemplating the installation of a production-scale electric smelting plant will be able to assess the practicability of their plans without incurring capital expense.

A Birlefco pilot furnace has been

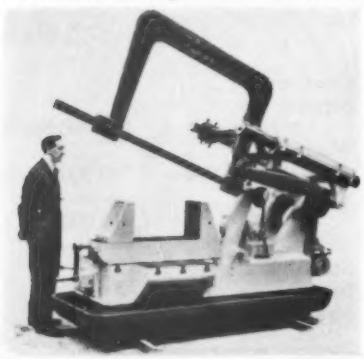
built at Aldridge to test mineral ores, on a contract basis, for their amenability to electric smelting. Particularly where hydro-electric resources are available, the electric smelting process can economically be used for the extraction from their ores of nickel, copper, manganese, iron, ferro-alloys, and other materials. Trial batches of ore will be accepted from any part of the world for testing on a miniature scale in the furnace. On completion of the test, a detailed report will be submitted, giving recommendations on smelting practice, electrical ratings, and size of full-scale installation required for a given output.

It is believed that the scheme will be specially attractive to mining and metallurgical concerns in the Commonwealth, particularly in Africa and India where the company and its associates has already installed a total of nine electric smelting furnaces with a combined rating of 36,000 kVA.

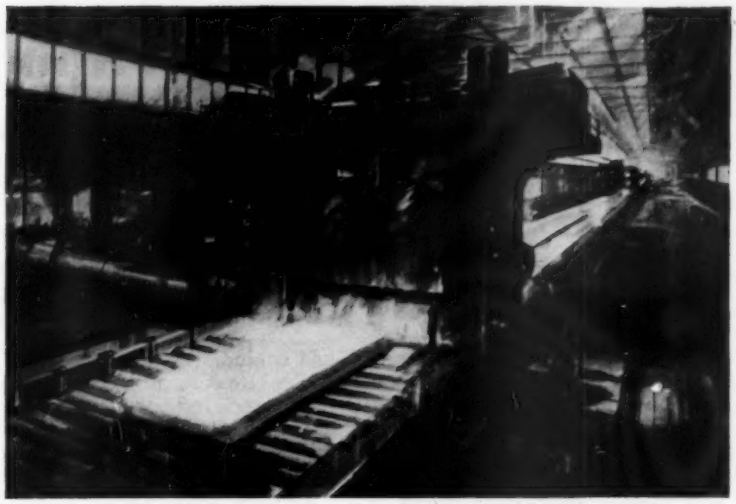
Rejuvenation

While it is common practice to replace old machine tools with new ones as a matter of policy or as opportunity offers, certain types seem to lend themselves to renovation and reconditioning. An instance of this kind occurred recently when Edward G. Herbert Limited, of Manchester, overhauled a hack-sawing machine which they originally supplied in 1918 and which had been in continuous use for over 40 years. The saw, a Rapidor No. 4, had a capacity of 26 in. × 26 in. but now, because of various modifications, is capable of cutting up to 28 in. × 28 in.

The machine was completely dismantled and all main faces replaned. New bearings, crankshaft, main slide bar, saw frame, bearing pads and slide bracket cap, were fitted, together with many new small components.



Rapidor No. 4 saw first supplied in 1918 and now completely modernized



WIDE ROLLING MILL.—The first of its kind in the U.K. aluminium industry, this new wide mill is now being installed at the Rogerstone works of Northern Aluminium Company Limited. It will enable the company to supply aluminium plate as much as 10 ft wide. The new mill of four-high reversing type, with a roll width of 12 ft is being built by Davy & United Engineering Limited

To bring the machine into line with all modern large capacity Rapidor saws a hydraulic lift and control unit was fitted. This assists the operation of reloading the machine quickly and also provides a range of feed speeds which covers a variety of work.

As a result of this overhaul including the modifications the owners now find that the output has been increased by about 50% and a 28 in. square cast iron ingot mould can be cut in just over four hours.

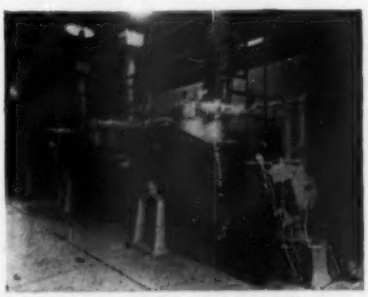
Computer Job-scheduling

A novel demonstration of automatic job-scheduling by an electronic computer was given by International Computers and Tabulators Limited at the Production Exhibition at Olympia, London, earlier this year. Visitors were invited to ask the earliest date by which a hypothetical engineering factory could meet their orders and what the cost would be. An I.C.T. Type 1202 computer gave the answer in a matter of seconds.

The data stored in the magnetic drum of the computer comprised for each of 60 possible parts: the part number; free stock, if any; unit stock cost; cost of raw material for a one-off job; and the last batch number. It also comprised the residual productive capacities, both for normal time and overtime, for each of 12 machine groups in the factory for 52 weeks ahead; the hours available per week on any machine of a group; the cost of an hour of each operation; the fixed charge per order; and the extra charge made for a priority order.

Finished parts available from stock were used first and the remaining demands were loaded in correct sequence. The computer then compared process time with machine capacity and also with residual group capacity and if this was not available an attempt was made to load in the next week and so on. Loading began on the next operation either in the same week or the succeeding one. The cost given was either the stock cost or a calculated figure based on machine time and raw materials used, or a combination of these factors.

Apart from firm orders, enquiries can also be handled by these computers, over thirty of which have already been ordered.



AIR FOR MARSHALLING.—An interesting feature of the new British Railways automatic marshalling yard at Margam near Port Talbot, claimed to be one of the largest and most modern in Europe, is the application of compressed air for operating the points and wagon retarders. Associated Electrical Industries—GRS Limited have installed three Broomwade, Type EH241, air compressors in the control tower to provide a 24-hour supply of compressed air. Delivering 300 cfm of free air at 100 psi they operate at 280 rpm.

Design of a Mixed Vapour Condenser

The design of a tube-in-shell condenser for the total condensation of a mixture of benzene and water vapour with a sub-cooling zone is considered and some constructional details which resulted from the operation of such a condenser are reviewed.

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THE Tyrer process (1) is favoured for the batch or discontinuous sulphonation of benzene to benzene sulphonic acid. The process in general consists of introducing the requisite charge of liquid benzene into a cast iron jacketed vessel fitted with a turbo-mixer. A corresponding charge of commercial sulphuric acid, 96% strength, is introduced gradually into the vessel, the temperature being controlled by circulating cooling water round the jacket. After completion of the addition of the sulphuric acid charge, the cooling water is ejected from the jacket and replaced with steam at a pressure of approximately 100 psi.

Benzene vapours from a steam-heated tubular heat exchanger are then introduced into the heated diluted acid mixture through a pipe extending below the inlet edge of the turbo-mixer at the bottom of the sulphonator.

The vapours of benzene bubbling through the mix entrain the water of reaction in the form of steam and the mixed vapours of benzene and steam, after passing through a caustic scrubber to remove entrained acid mist, are then condensed in a tubular condenser.

The condensate is passed to a decanter or separator, the benzene layer being separated and returned to the circulation tank, whence it is pumped at a controlled rate through the heat exchanger, vaporized, and thence as recirculated vapour back to the sulphonator.

The design of the shell and tube condenser provided a simple test case for the various theories of the condensation of mixed vapours.

A review of these methods of calculation has recently been given by Haselden and Platt (2). Although this review is specifically directed to rather more refined methods required for accurate design when small temperature differences exist, and concedes that for cases such as the one under consideration, where the temperature difference between vapour and coolant is considerable, all the existing methods give results in good agreement with each other.

In these circumstances it was felt that the method of treatment considered very fully by Kern (3) would be most suitable, although it is conceded that this disregards the effect of the vapour film. Although there is some disagreement on the correct methods of quantitative design, there is little disagreement on the desirable features to be incorporated in a condenser for a binary mixture.

To minimize the thermal resistance of the condensate layer, vapour drag should be used to aid drainage of the condensate, and hence it is better to have the vapour flowing vertically downwards through the condenser.

To promote mass transfer in and between the phases it is necessary to have the maximum degree of mixing in each phase, this mixing in the case of the vapour being achieved by turbulent flow and by changes of direction, and in the liquid film by baffling and similar changes in direction.

In a case such as the present, where one component is highly volatile at ambient temperatures, it is advantageous to employ a portion of the condenser surface for sub-cooling of the condensate. The condenser, after consideration of the process, was designed on these lines using the following flow sheet data.

Flow sheet data

Benzene 2 gpm. Water vapour 3 gpm.

Temperature of vapours at inlet to condenser	= 228° F
Temperature of condensate at outlet	= 130° F
Cooling water inlet temperature	= 78° F
Cooling water outlet temperature	= 100° F

Due to difficulties with head room, as well as to the increased heat transfer coefficients, a horizontal condenser inclined at a slight angle to provide drainage was adopted. The preliminary design was with $\frac{3}{4}$ in. O/D copper tubes, 16 S.W.G. wall, arranged on a $1\frac{5}{16}$ triangular pitch at 10 ft between tube plates.

Process data

Physical properties of benzene

Specific heat at 228° F	= 0·23 Btu/lb°F
Specific heat at 130° F	= 0·4 Btu/lb
Density at 60° F	= 0·87
Latent heat vaporization	= 169 Btu/lb

Physical properties of water vapour

Specific heat at 228° F	= 0·17 Btu/lb°F
Latent heat of steam	= 970 Btu/lb

Quantities

Benzene = 8·7 × 120 = 1040 lb/hr
Water = 30 × 60 = 1800 lb/hr

Heat balance

Superheat

Water = 1800 × 0·17 × 16 = 4900 Btu/hr
Benzene = 1040 × 0·23 × 16 = 3825 Btu/hr
8725 Btu/hr

Condensation

Benzene = 1040 × 169 = 175,000 Btu/hr
Water = 1800 × 970 = 1,740,000 Btu/hr
1,915,000

Sub-cooling

Benzene = 1040×0·40×82
Water = 1800×1·0×82
= 181,000 Btu/hr

Heat removed =
1,923,725 Btu/hr condensation
181,000 Btu/hr sub-cooling
Total Heat=2,104,725 Btu/hr

Water cooling requirements
$= 2,104,725/22$
$= 95,500$ lb/hr

Using a pipe velocity of 6 fps
Area of $\frac{3}{4}$ in. O/D, 16 S.W.G. pipe
$= \frac{1}{4}\pi \times (\frac{5}{8})^2 \times (1/144)$
$95,500/(62{\cdot}4 \times 3600)$
$= (n6\pi \times 25)/(4 \times 64 \times 144)$
$n = 33{\cdot}4$

Using 40 tubes per pass with three passes gives 120 tubes total.

Where the condensation of the binary mixture results in the formation of a single liquid compound and water, the compound being immiscible with water as in the present case, Hazelton and Baker (4) carried out experimental work on a single vertical tube condensing benzene, toluene and chlorobenzene with steam and found that film coefficients were independent of the temperature drop across the condensate film and independent of the properties of the liquid condensed with water.

The coefficient for vertical tubes was found to be

$$h = 79\left[\frac{(wt\%)_a\lambda_a + (wt\%)_b\lambda_b}{(wt\%)_a L}\right]^{\frac{1}{4}}$$

where a b refer to the organic and water respectively and L is the tube length in feet.

For horizontal tubes

$$h = 61\left[\frac{(wt\%)_a\lambda_a + (wt\%)_b\lambda_b}{(wt\%)_a\, Do}\right]^{\frac{1}{4}}$$

$$h = 61\left[\frac{1040 \times 169 \times 1800 \times 970}{1040 \times 0{\cdot}75/12}\right]^{\frac{1}{4}}$$

$= 450$

Other work by Baker and Tsao (5), and Baker and Mueller (6) generally confirms this result. They found that for vapour mixtures which form immiscible condensates, film coefficients of over 400 Btu/hr ft^2 °F are usually obtained. For normal condensation of a simple compound the equation for the film coefficient for condensation on horizontal tubes is given by

$h[(\mu f)/(K_f\rho_f g)]^{1/3} = 1{\cdot}51(4G''/\mu)^{-1/3}$

where the loading for a single horizontal tube is

$$G'' = W/LN_t$$

With horizontal tubes in tube bundles, it has been found that the splashing of the condensate as it drips over successive rows of tubes causes G'' to be more nearly proportional to $(N_t)^{2/3}$ rather than N_t, so that for horizontal tube bundles

$$G'' = W/(LN_t)^{2/3}$$

The relative merits of horizontal and vertical condenser sub-coolers are well considered by Kern.

The vertical condenser has the advantage of well defined zones, but is restricted by the available height, and has a smaller condensing film coefficient than the horizontal condenser.

The horizontal condenser sub-cooler gives considerably higher overall clean coefficients and the majority of the condenser sub-coolers used in industry are of the horizontal type with approximately 25% of the surface available for sub-cooling.

Hot fluid shell side

$G'' = W/(LN_t)^{2/3} = 2840/(10 \times 120^{2/3})$
$= 12{\cdot}2$

Using the graph for quick determination of previous equation given in Kern (page 267, Fig. 12, 9)

$h = h_o = 250$

h_i for water in tube by Sieder and Tate equation $= 940$

$h_{io} = 777$

Then clean overall coefficient
$U_c = (h_{io}\, h_o)/(h_{io} + h_o)$
$= 777 \times 250/1027 = 188$

Condensing $(\Delta t)_c = 1,923,725/112$
$= 17,700$ Btu/hr°F

Subcooling $(\Delta t)_s = 181,000/52$
$= 3500$ Btu/hr°F
$21,200$ Btu/hr°F

$\Delta t = 2,104,725/21,200 = 99{\cdot}5$°F

Average temperature of condensing vapour

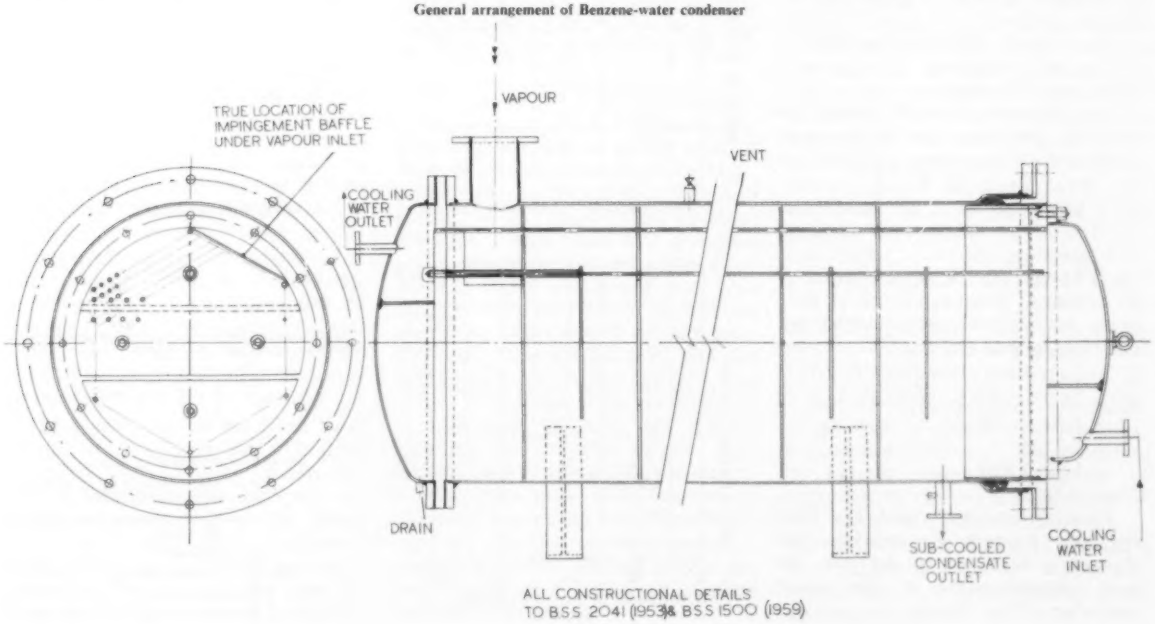
$T_v = (228 + 212)/2 = 222$°F

$t_w = 89 + 250/(777 + 250)\,(222\text{-}89)$
$= 89 + (250 \times 133)/1027$
$89 + 324 = 121{\cdot}4$°F

$t_f = (T_v \times t_w)/2 = (222 + 121{\cdot}4)/2$
$= 171.7$°F

Benzene	*Water vapour*
$K_f = 0{\cdot}092$ Btu/hr	$K_f = 0{\cdot}0137$ Btu/hr
$\rho_f = 0{\cdot}88$	$\rho = 1{\cdot}0$
$\mu_f = 0{\cdot}22$ *cp*	$\mu = 0{\cdot}25$ *cp*

General arrangement of Benzene-water condenser



ALL CONSTRUCTIONAL DETAILS TO B.S.S. 2041 (1953) & B.S.S. 1500 (1959)

Clean surface for condensation
$A_c = 1{,}923{,}725/(188 \times 99{\cdot}5) = 103$ ft²
Sub-cooling Free convection film coefficient = 50.
Clean overall coefficient for sub-cooling
$U_s = 777 \times 50/827 = 47$ Btu/hr ft² °F
Clean surface for sub-cooling A_s
$A_s = 181{,}000/(47 \times 52) = 73{\cdot}5$ ft²
Total clean surface required
= 103 + 73·5
= 176·5 ft²
Length of tubes = 176·5/23·5 ft²
= 7 ft 7 in.
With 10 ft tubes, dirty overall coefficient U_D
= 1,923,725/(176 × 99·5) = 110
Then dirt factor
$= (U_C - U_D)/U_C U_D$
$= (188 - 110)/(188 \times 110)$
= 0·00378 hr ft² °F/Btu
This is satisfactory.

Construction

Minimum shell diameter
$\frac{3}{4}$ in. O/D tubes on $\frac{15}{16}$ in. triangular pitch, three pass $16\frac{3}{4} \times \frac{15}{16} = 15\frac{1}{4}$ in.
Flange width on floating head, 3 in.
Main shell, $21\frac{1}{4}$ in. inside dia
22 in. outside dia
Actual number of tubes on centre line = 16.

Baffle spacing

Velocity of vapour = U fps
If Q = cu ft/sec
vapour = 15·7 cu ft/sec
U fps = $144Q/(d_s - nd)L$
d_s = shell diameter = 21·25 in.
$nd = 16 \times \frac{3}{4}$ = 12 in.
L = baffle spacing
If U = 10 fps
$L = (144 \times 15{\cdot}7)/(9{\cdot}25 \times 10)$
= 24 in. spacing

Tube sheet thickness

The following formula should be used in calculating the thickness of tube sheets when using straight tubes

$$T = D\sqrt{0{\cdot}25P/5 + C}$$

T = Thickness of tube sheet measured at bottom of partition grooves, in.
D = Mean gasket diameter, in.
P = Design pressure = 2 × *W.P.*
S = Allowable working stress according to B.S.2041.
C = Corrosion allowance

$T = 24{\cdot}75\sqrt{0{\cdot}25 \times 90/8000} + \frac{1}{16}$ in
= 1·31 + 0·0625
= 1·3725
= $1\frac{3}{8}$ in. thick.

Size of bolts

Floating head and gland. The fluid pressure tending to separate the flanges is assumed to act over an area corresponding to the inner diameter of the flange.

Working pressure = 45 psi. Then total load
$P = \frac{1}{4}\pi \times (15\frac{1}{4})^2 \times 45 = 8200$ lb

The allowable working stress in bolts increases with the size of the bolt due to the decreasing effect of stresses from initial tightening for bolts of the size required. In this case a safe value for the working stress would be 6000 psi.
Then if d = root diameter of bolt and the number = 12
Then $\frac{1}{4}\pi \times d^2 \times 6000 = 8200/12$
$d^2 = (4 \times 8200)/\pi \times 6000 \times 12)$
$= 0{\cdot}21$
$d = 0{\cdot}46$ in. dia
This corresponds with $\frac{1}{2}$ in. B.S.W. bolts.

Thickness of flange

Considering the flange as a uniformly loaded cantilever between bolt centres

Then modulus of bending of section around neutral axis is $\frac{1}{6}Pt^2$ and bending moment = $8200 \times 6/12$
$= 8200 \times 2\frac{1}{2}/12$
Since bending moment = bending stress × modulus of section
$8200 \times 2\frac{1}{2}/12 \times \frac{1}{6}Pt^2 \times f_b$
f_b = safe value for mild steel = 5000 psi
$P.C.D = 17\frac{3}{4}$ in. dia
Then
$t^2 = [(8200/12)]$
$\times [(2\frac{1}{2} \times 6 \times 12)/(\pi \times 17\frac{3}{4} \times 5{,}000)]$
$= 0{\cdot}445$
$t = 0{\cdot}675$, say $\frac{11}{16}$ in. thick.
Similar calculation for the fixed head flange and bolts give flange thickness = $\frac{7}{8}$ in. and bolt dia = $\frac{3}{4}$ in.

Pressure drop calculations

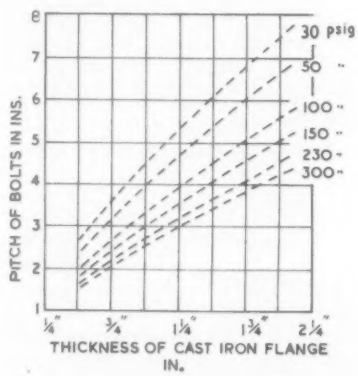
Kern suggests that the entrance and exit losses be estimated equal to those of one velocity head and that channel and floating head losses be assumed equal to four velocity heads.

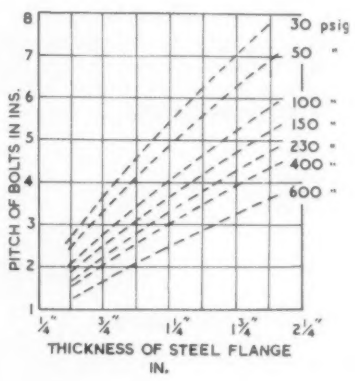
The equation proposed by Chilton and Genereaux [7] is probably the best for calculation of shell side pressure drops and is as follows:

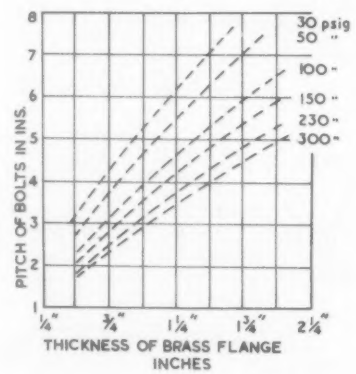
$\Delta P = 4f\rho(V_{max})^2 N/2g \times 144$
$= 0{\cdot}000432\,(f\rho(V_{max})^2 N)$
ΔP = pressure drop, psi per pass
V_{max} = velocity based on flow through space in tubes, ft per sec
ρ = fluid density
N = number of horizontal rows
f = friction factor
g = gravitational constant = 32·2 ft per sec².

Values of friction factor are obtained from the correlation featured in the T.E.M.A. Standard Handbook. This friction factor must be divided by the Sieder and Tate correction factor for temperature effects

$$(\mu/\mu_w)^{0{\cdot}14}$$







The thickness of flanges for heat exchangers calculated according to the deflexion formula

$$P\,t = \frac{K\,(t \text{ in } \frac{1}{16} \text{ of inch})^3}{p}$$

where P = pitch of Bolts in in.
p = Max. design working pressure at temperature in psig
t = Flange thickness less corrosion allowance
K = constant
Thus K = 3·0 for Cast Iron
K = 3·5 for Steel
K = 5·5 for Brass

In addition to the cross flow pressure drop a pressure drop occurs across the baffle and has been given by Donohue [8] as $\Delta P = \rho V^2/144g$ V = Velocity through baffle opening ft/sec. Δp = pressure drop psi per baffle opening.

Considerable corrosion was encountered at the shell side of the tube plate and this was traced to galvanic couples formed between the copper tube and the mild steel tube sheet. To overcome this, the ends of the copper tubes were sheathed in brass ferrules prior to rolling the tube ends into the sheet. This satisfactorily overcame the corrosion problem.

The rating conformed to design over periods of six months and then fell away. This was traced to sludge in the river water used for cooling and was overcome by fitting Autoklean strainers in the water inlet line.

References

(1) Tyrer, U.S. Patent 1,210, 725 (1917).
(2) Haselden & Platt, *British Chem. Eng.* Vol. 5 (*November* 1959).
(3) Kern, *Process Heat Transfer*, McGraw-Hill Book Co. Ltd. (1950).
(4) Hazelton & Baker, E. M., *Trans. A.I. Chem. E.*, 40, 1-29 (1944).
(5) Baker & Tsao, *Trans. A.I. Chem. E.* 36, 517 (1940).
(6) Baker & Mueller, *Ind. Eng. Chem.*, 29, 1067 (1937).
(7) Chilton, T. H. & Genereaux, R. P. *Trans. A.M. Inst. Chem. Eng.* 29, 161 (1933).
(8) Donohue, D. A., *Ind. Eng. Chem.* 41, 62 (1949).

Handling Plant for Aluminium Swarf

A handling, storage and sifting plant for the manufacture of exothermic compounds has been supplied to Berk Exothermics Limited by Thomas Robinson & Son Limited, Rochdale. The compounds are for risers used in the foundry industry and their manufacture in Britain is comparatively new. The comprehensive storage, handling and sifting plant is for aluminium swarf which is the primary material used in the manufacture of the compounds. The swarf used includes dressings, grindings and dross from casting producers, and powdered refined aluminium. Highly efficient sifting is required to produce the mesh size necessary for quality production.

The swarf is fed to the plant from outside the building via a hopper equipped with a dust extraction canopy coupled to the main exhaust system. Conveyance of the swarf from the hopper to a Robinson Rexman screening machine is accomplished at the rate of five tons an hour by a bucket elevator independently driven by an electric motor.

The screening machine has a totally enclosed leak proof sieve securely clamped in a steel frame. This sieve frame is driven from the feed end by a gearless mechanism which, by means of special carrying rods supporting the sieve frame, imparts a rotary action at the feed end and a reciprocating action at the tail end. Rubber ball cleaners are fitted below the sieve and keep the cover free from obstruction and operating at maximum efficiency. Two separations are effected by the machine installed. They are the throughs of 16's wire mesh (1·24 mm. aperture) and the overtailed rejects which fall by Robinson gravity spouting to a 2-ton capacity rejects bin for out-loading.

A further elevator is used to convey the throughs of the screening machine to the worm conveyor, mounted above the six 10-ton capacity steel storage bins, where the swarf is deposited in its respective bin according to its aluminium content. All delivery slides fitted below the worm conveyor used for depositing the swarf into the bins are controlled by chains from the ground floor.

The gravity discharge of swarf from the storage bins to the worm conveyor beneath is controlled by adjustable slides fitted to the connecting spouts. Discharge from the bin is effected at the rate of three tons per hour, the conveyor delivering to a further elevator which feeds a Robinson Minisifter mounted on the platform at the end of the line of bins.

The Minisifter is a compact machine occupying a floor area only 4 ft × 4 ft but with a sifting area of 54 sq ft. It has a stack of six leak-proof sieves, clamped to a base and gyrated in a 2 in. (51 mm) circle at 250 rpm. Three mesh size products are produced by this machine. They are the swarf which will not pass through 40's wire mesh (0·503 mm aperture), swarf which will not pass 70's wire mesh (0·261 mm) and the swarf which passes through 70's wire mesh. These three mesh size products are allowed to flow by gravity spouting to portable metal containers, each holding 100 lb of swarf. To facilitate easy identification of the mesh size of the swarf, coloured tags are attached to each container as they are filled. The containers are then placed on a pallet and stacked by fork lift truck.

Aluminium swarf, iron oxide, dextrine and other chemicals used in the manufacture of Exoberk are mixed in a 5-ton batch mixer for two hours and a number of laboratory tests are made before the compound is passed for packing.

This material, which can produce intense heat by chemical reaction, can supply heat to the metal within a riser and thus reduce the amount of metal required, at the same time establishing a temperature gradient within the casting. The conductivity of the burnt out residue compares favourably with conventional insulating refractory materials.

All motors within the plant are flame proofed and are started from control panels in an adjacent building. They cannot be started until the warning horn has been operated for a period of 15 seconds. A further delay of 45 seconds occurs before the first motor can be operated and the sequence commences with the Minisifter at the delivery end of the plant. This ensures that all machinery is operating before swarf commences to enter the plant.

Simlac Minor Computer

A new small capacity general purpose analogue computer named Simlac Minor is being made by Short Brothers and Harland Limited, Belfast, for users who require greater capacity than is available in Shorts' 18-amplifier General Purpose Computer, but who do not require the capacity or higher accuracy of the recently announced large Simlac computer. The instrument has a capacity of 32 amplifiers and 100 passive elements and like the larger version is of standard rack construction, the entire computer being housed in two 19 in. Post Office type racks. The left-hand rack contains the computing elements and the right-hand rack houses the instrumentation, removable patch panels, power units and three special non-linear units.

To obtain maximum utilization of the space available oven-stabilization is not employed. Nevertheless, by careful design and choice of components the overall accuracy of the computing elements is 0·1%. The amplifiers and passive elements are standard Simlac equipment except that the "hold" facility is an optional extra.

Computers for Process Control

The suitability of a digital computer for a particular control application depends on such factors as computation speed, logical and mathematical capabilities, input-output requirements, and reliability and maintainability. Integral and incremental computers each have inherent and distinctive design and operational features; these play a significant role in the evaluation of computer suitability.

By EDWARD L. BRAUN, Genesys Corporation

ONE criterion for classifying digital computers is by the nature of information transmissions on their internal communication lines. Using this criterion, general purpose (GP) computers are classified as integral transfer machines and digital differential analysers (DDA) as incremental transfer machines. Each type may have a variable of fixed programme depending on its application: general or particular.

Integral computers

The integral transfer computer solves problems by procedures similar to those used by a person operating a desk calculator. The digital computer, however, performs all computing and data transfer operations at high speed and stores and executes a complete programme without interruption.

A simplified information flow diagram for an integral computer is shown in Fig. 1. Initial values, measured variables, constants, and a detailed programme are entered in the main storage unit. The main store usually has a capacity of thousands of words, each word consisting of about 20 to 40 binary digits. Single items of data are taken from this store, operated on individually, or combined mathematically or logically with another item of data taken from the arithmetic unit; and the result is either left in the arithmetic unit for further processing, returned to the store, or transferred to some piece of output equipment. The control unit establishes transmission paths between the store, arithmetic unit, input-output equipment, and its own sequence control.

To facilitate programming, the machine executes a variety of arithmetic, logical, and data transfer instructions. The codes for instructions are interpreted and cause the generation of specific operations required in the execution of each instruction by means of the decoding and encoding function tables. Instructions and operands are taken from the main store in accordance with the contents of the instruction address counter and the operand address register, respectively.

Two aspects of integral transfer operation add to the time required to execute a programme. The first is that in operating on continuous variables, the arithmetic unit performs a considerable amount of redundant computing: it does not utilize the result of the same type of operation on the preceding value of the variable. The second aspect is that when using a dynamic type of main store (such as drum or disc memories), appreciable time is consumed in waiting for access to specific storage locations.

To perform the operation of multiplication in an integral computer (for example, to form AB) A and B must each be selected from the main store and directed to the proper register (A) in the arithmetic unit, a complete multiplication performed, and the result transferred back to some location in the main store. Thus considerable transfer of data occurs within the integral computer, compared with the simplicity of multiplication in the incremental computer.

Incremental computers

The incremental computer performs its basic operation, serial summation, in such a manner that it approximates the process of integration, Fig. 2A, to any desired degree of precision within the machine's capacity. Here:

$$\int y dx \cong Y \Delta X$$

The basic integrator, Fig. 2B, consists of two registers, R and Y. The contents of the Y register—the initial value Y_o plus the summation of the ΔY input pulses—are added to or subtracted from the R register under control of the ΔX pulse. The output of the R register is its overflow ΔZ, and the integral is then the summation of

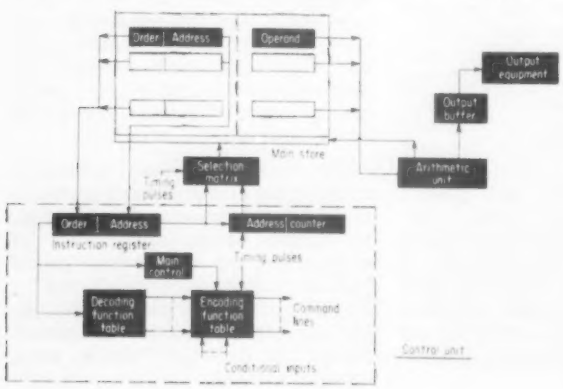
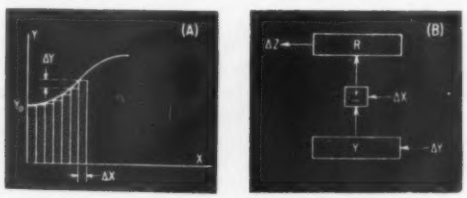


Fig. 1 (left).—Information flow in a single address integral (general purpose) computer

Fig. 2 (below).—In an incremental computer, integration is performed by serial summation. The change in Y, ΔY, is added to the contents of the Y register. Under influence of the ΔX pulse, the Y register contents are added to the R register. The R register overflow, ΔZ, when summed, approximates the integral



the ΔZ pulses:

$$\Sigma \Delta Z = Y \Delta X \cong ydx$$

The incremental computer contains digital capacity to form many such operational integrators, Fig. 3. The solution of any problem involving continuous variables is accomplished by specifying an interconnexion of integrators which simulates the interrelations of variables in the equations being solved. (All other operations like multiplication, division, function generation, and differentiation required in the course of solution are derived by causing specified combinations of variables to enter operational units as in analogue computers.)

In keeping with a serial mode of operation, each integrator functions in turn and then idles while another integrator functions. Even if the *Y* and *R* registers are formed from active elements (flip-flops or binary counters), during any computation period the states of all integrator elements would remain unchanged, with the exception of the integrator currently being operated upon. This fact, plus the availability of an economical passive storage system like a magnetic drum or disc memory, leads to an important advantage: passive storage cells may be substituted for the active storage elements without any degradation of performance. Accordingly, individual integrators are formed from pairs of words, the *Y* and *R* registers, stored in two long delay lines on a magnetic surface. The rules for operating on these registers are stored in relatively simple control logic circuits. In Fig. 3, as the magnetic surface rotates, successive bits of each integrator appear at the reading heads, are operated on according to the rules built into the control circuitry, and the results are returned to the magnetic store.

In a DDA the central store, the *dz* store, holds the up-to-date outputs of all operational units. Its capacity is determined by the number of operational units in the machine and the number of bits required to represent the incremental outputs of these units. Usually the size of the *dz* store is less than a few hundred bits.

In large measure, economies are effected in the DDA by the establishment of a simple, ordered arrangement of data and a relationship throughout the machine between each item in storage and the times within a major or minor cycle that the item is accessible to one or more read heads. There is zero access time to the *dz* store for the recording of each operational unit's output because outputs are always recorded at a specified time

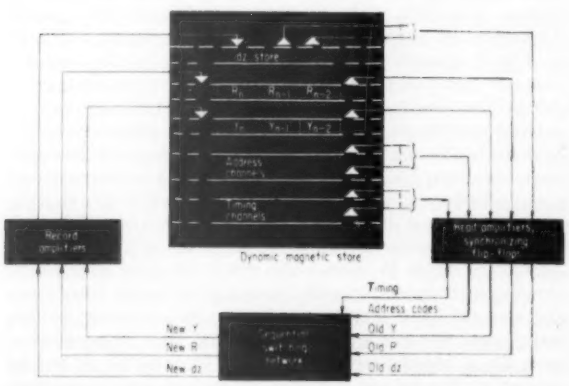


Fig. 3.—Information flow in an incremental (DDA) computer

near the end of the active period of each unit. Since these times are fixed and predeterminable, a correspondence can be established between them and specified positions in the central store.

The times at which specific items in the *dz* store will be accessible to fixed reading heads is ascertainable from the knowledge of when these items were recorded and the store's delay characteristics. In practice, one or more *dz* reading heads are so placed that all specified inputs to an operational unit can be read during the active period of the preceding unit. Therefore when an integrator's active period begins, all information required from the *dz* store has already been selected and made available to the integrator. Thus there is zero access time for reading data from the *dz* store.

The control logic for selecting items from the central *dz* store is also simple. The inputs to each integrator consist (except for inputs from external sources) simply of the outputs of certain specified integrators within the machine. Any one of these outputs, stored in the *dz* central file, can serve as the *dx* input to an integrator and one or more of them constitute the Σdy input. To determine the value of *dx* for any given integrator, then, it is only necessary to read the appropriate cell in the *dz* central store; to determine Σdy, it is only necessary to read the *dz* central store and sum all values of *dz* that, in total, constitute the Σdy input to the integrator.

If the machine contains a small number of integrators (less than the number of bits per integrator), the entire contents of the *dz* store can be read from a single reading head during the integrator's active period. For many integrators the entire contents of the *dz* store can still be read during a period corresponding to the length of a single integrator by using a number of heads suitably placed along the *dz* line. In either case, specific items in the store can be selected by the detection of coincidence between marker pulses in one or more address channels and the binary contents of each *dz* storage cell.

Decoding markers serve two important functions. First, they specify which integrator input and output "lines" are to be interconnected. In this way they are equivalent to the physical wiring and plugboard arrangement interconnecting integrators in an analogue computer. Second, in conjunction with simple decoding circuitry, they cause the value of items in the central *dz* store to be sensed and selected.

A unique feature of the DDA is that the result of a previous computation is always stored, and only incremental adjustments to the result are generated during succeeding computation periods. This mode of operation reduces the complexity of information transfer operations, for only increments rather than whole numbers have to be transferred internally and, as pointed out, these relatively simple transfers are done in a fixed, systematic manner.

As an example, consider the operation of multiplying changing values of *A* and *B*. This can be represented by:

$$(A+\Delta A)\ (B+\Delta B) = AB+\ (A\,\Delta B+B\,\Delta A+\Delta A\,\Delta B)$$

So the incremental computer merely must form $\Delta(AB) = (A\,\Delta B+B\,\Delta A+\Delta A\,\Delta B)$ and add it to the previously computed product *AB*. If a trapezoidal integration scheme is employed, only one integrator is required to form each of the following two terms:

$$(A+\Delta A/2)\,\Delta B \text{ and } (B+\Delta B/2)\,\Delta A$$

The sum of these terms is: $A\,\Delta B+B\,\Delta A+\Delta A\,\Delta B = \Delta(AB)$. Thus the product is formed by a simple

addition process in two integrators and the summation of the outputs of these integrators.

Criteria for Control Applications

The design and operation of integral and incremental computers determine how well they meet certain criteria for control applications. Among the important considerations are computer speed, logical and mathematical capabilities, input-output requirements, reliability, and maintainability.

Computer speed

The speed of a digital computer for control applications can itself be measured in terms of two important criteria: computation frequency and slewing time.

Computation frequency.—This is the reciprocal of the time required for a single iteration of a computational programme. It determines the maximum frequency component and bandwidth of input data to which the computer can respond. This bandwidth is, in practice, approximately one-eighth to one-fourth the computation frequency.

It is difficult to make a general comparison of the computation frequency capabilities of integral and incremental transfer computers. Even for two specific machines the comparison is affected by the particular mathematical formulation and programme employed for problem solution. To provide a guidepost, however, the accompanying table lists some representative figures for the time required to carry out certain basic arithmetical operations in incremental and integral transfer machines. It is assumed that both machines use a magnetic drum or disc memory as the main store. The value of n in the table is usually between 15 and 20 word times. The access time, with minimum-access programming, is usually between 5 and 10 word times. Programmes for generating the sine or cosine may require about 20 to 30 simple operations like addition and internal transfers of data and about six multiplications.

The table indicates that for computations on continuous variables, incremental computations are about an order of magnitude faster than integral computations. This feature is important in a control system where time delays introduced by the computer can lead to system instability. The computation frequency of the incremental machine would be about 100 to 200 iterations per second—satisfactory in control systems with bandwidths of 0 to 25 or 50 cps. The integral machine would have a computation frequency of about 10 to 20 iterations per second—satisfactory in systems with bandwidths of 0 to 2·5 or 5 cps.

Slewing time.—This is the time required for a computer to progress from one state to a new state as demanded by a sudden, large change in the value of one or more inputs. To generate a problem solution corresponding to the new sets of values of the input variables, without introducing a large time lag, the computer must be able to generate large changes in a variable during each iteration period.

An integral machine requires only one computation period for the effects of a change (no matter how great, provided it is within the capacity of the machine) to be recognized. Here slewing time is not related to accuracy, although the number of computation periods required for a problem solution does depend to some extent on the accuracy required and the nature of the problem.

In an incremental machine the slewing time depends on the number of increments to be generated. The number of increments depends, in turn, on the magnitude of the change and the scale factor of the variable. In a single-increment computer the number of computation periods increases in inverse proportion to the allowable error or precision, because allowable error determines the scale of the independent variable. Therefore, one can obtain adequate precision at the cost of a relatively large number of computation periods for the solution of a given problem. Generally speaking then, as far as slewing time is concerned, an integral transfer machine is superior to an incremental machine.

Certain modifications can be made in incremental machines to reduce slewing time. In early DDA machines no more than a single increment could be generated by an operational unit during each computation period. Accordingly, for control applications the computation period was chosen sufficiently small so that under normal dynamic operation the input variables of the controlled device would not change by more than a single increment during this time. That is, the fixed slewing rate was made roughly equal to the normal rate of change of the variables.

Situations can arise, however, where the values of one or more variables change abruptly. In this case a slow slewing time introduces a lag and serious dynamic error. The slewing rate limitation, serious only in relatively high speed control applications, can be alleviated by increasing the increment size, i.e., reducing the scale factor whenever a large slewing rate becomes necessary. One way of doing this is to provide a register which accumulates the difference between the value of a variable stored within the machine from a preceding measurement and the new value entering the machine. When this difference exceeds a predetermined amount, a signal can automatically be generated causing the entire machine to operate at a reduced scale factor (with larger increments) until the difference in the register drops below the predetermined level and returns the machine to the normal increment rate.

Instead of a single, fixed increment rate, one can incorporate a number of slewing rates, each brought into play when the difference between the actual and desired values is within each of certain predetermined ranges. The effect of having several slewing increments is shown in Fig. 4. Graph A shows the response of the integral transfer computer which requires only one computation period for slewing time. Graph D shows the response for a fixed increment computer which takes 25 computation periods to change the required 25 increments of the input variable. Graph C shows the response for an incremental computer having a normal fixed increment and a slewing increment equal to 16 times the normal increment. In this case the response time is reduced to 10 computation periods. Graph B shows the response time when two slewing increments, one 16 times and the other four times the normal fixed increment, are made available. In this latter case the response time is only four computation periods, a significant reduction in slewing time, but of course at the added expense of equipment to produce the variable slewing rates.

WORD TIMES FOR BASIC ARITHMETIC OPERATIONS

Operation	Word times for execution	
	Incremental	*Integral*
Add, subtract	1	1 + access time
Multiply	2	n + access time
Divide	4	n + access time
Sine, cosine	1	Function of numerical approximation
Integrate	1	Function of numerical approximation

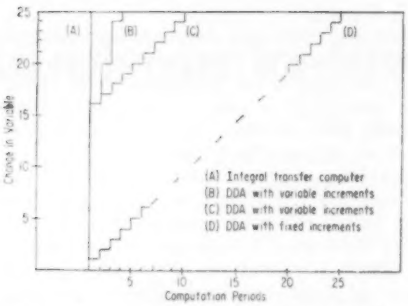


Fig. 4.—Response times of different computer mechanizations. Using variable slewing increments in the incremental computer, graphs B and C, decreases the slewing time

The problem of generating a number of increments corresponding to a change in a variable within a minmum number of computation periods by accumulating different standard sized increments in analogous to the problem of determining the unknown weight of an object with a minimum number of trials. The unknown value is most rapidly determined if each member of the standard set of weights is a member of a geometric progression with a common ratio of two. The value of the largest increment should be at least one-half the minimum anticipated unknown, and the value of the smallest depends on the desired measurement precision.

The variable increment slewing operation is controlled as follows: each input to the machine is compared with the corresponding input received during the preceding period. The largest increment size less than this difference is then selected and added to the input from the preceding period, and the new value is stored for use in the succeeding period. Simultaneously the computation is updated by an amount corresponding to the chosen increment. The procedure is repeated until the output is an exact solution of the problem.

Logical and mathematical capabilities

The relative merits of integral and incremental transfer machines differ for three different types of information processing procedures: computations on continuous variables, decision making, and data processing.

Computation on continuous variables.—The incremental machine can perform numerical integrations as well as algebraic and trigonometric operations on continuous quantities in less time and with less equipment than a comparable integral transfer machine. This capability, based on the fact that in any given period it utilizes information generated in the preceding period, can be capitalized in control systems where the quantities are continuously variable and limited in excursion and rate.

Decision making.—If a computer is to schedule different computations to provide overall supervisory control, it must be able to make timely decisions based on logical considerations and to call for different individual computations as required. An integral transfer machine can initiate a new computation after only one computation period, thus introducing no significant time delay. The incremental machine, on the other hand, may require a large number of periods. Thus, though the incremental machine has no intrinsic difficulty in making a decision, it may introduce significant lag in implementing the decision. If it does not have the capability to initiate a new computation on demand, then one obvious but uneconomical procedure would be simultaneously to compute all functions that may be required and implement a decision by switching to the functions required. In closed-loop systems, anticipatory circuits which make both the functions and their time derivatives available to provide both error and error rate control may be used to speed decision making of incremental computers.

Data processing.—The integral transfer machine may be used for a variety of general data processing applications, including sorting and collating of digital data and the processing of noisy data of low correlation. The incremental computer is not well suited for these applications nor for problems of logical analysis, because such applications usually involve large changes in the contents of registers in each computation period.

Input-output requirements

Data can be entered into a digital computer in three different forms :

1. Binary weighted pulses whose sum is proportional to the whole or integral value of a sampled input variable. The binary number may be serial in the form of pulse trains in which case each pulse is read sequentially or in parallel in which case all pulses are read simultaneously (integral measure).

2. A number of equally weighted pulses proportional to a change or increment in the input (incremental measure).

3. A pulse rate proportional to the value of the sampled input.

Arrangements are possible that allow data in any of these forms to be used as an input to either type of digital machine. Normally, integral measure (form 1) would be used with an integral machine, whereas either integral or incremental measure (forms 1 or 2) may be used with an incremental machine. An incremental data conversion and transmission system is more economical of equipment and more compatible with the basic nature of an incremental machine. If binary weighted integral input data is used with an incremental computer, special registers, termed servo-registers, generate unitary weighted pulse trains from the integral input data. (This is done by subtracting one increment at a time from the contents of a servo register until it is cleared.) Data in this form can then be used as inputs to other operational elements.

A major consideration in selecting either integral or incremental measure is the effect of a permanent offset caused by losing an increment as a result of some system malfunction. The choice will therefore be influenced by the reliability of the data input-output system, and whether it is within a broader closed loop with zero steady-state error or within a system where new absolute references can be inserted at specified intervals.

Variable pulse rate data (form 3) is obtainable, for example, from certain types of pressure and flow meters. This data can readily be converted to binary weighted representation by accumulating, within a counter, the pulses received over some specified interval.

Output signals in the form of integral numbers can be obtained from incremental as well as integral transfer machines, since storage registers are available for accumulating incremental quantities. Output signals in the form of incremental quantities may also be obtained from either type of machine since in an integral transfer machine, increments may be obtained by forming the differences between successive outputs.

Reliability and maintainability

Because large economic losses would be incurred by

shutdowns of a process control operation, equipment reliability is of prime importance. Basically, system reliability depends on good electrical and mechanical design. Straightforward and uncomplicated logical design, the availability of test programmes, and special test facilities all contribute to good maintainability.

Reliability.—One measure of reliability of a computing system is the time interval over which the system operates satisfactorily. Two factors affect the reliability of a digital computer, namely malfunctions and failures. The malfunction is a temporary disturbance producing an error which may or may not propagate through the system. The failure results from a permanent change in the characteristics of a component such that it no longer satisfies the demands of its circuit.

The incremental machine has fewer failures simply because it has fewer components than a comparable integral machine. Also it has fewer malfunctions. However, malfunction errors may have widespread effect because the error may occur in time-shared equipment, and because the effect of an error may persist for a long time since in the incremental computer, new computations always utilize old data. Some malfunctions may cause only negligible trouble as in the cases where only one increment is affected or a relatively insignificant variable is altered.

In the integral computer most malfunctions cause only a temporary disturbance because, in general, the computations in one period are independent of those in the preceding period. It is only where the problem being solved needs data retained for more than one period that errors are not promptly removed.

Maintainability.—This refers to the ease with which an existing fault may be found and corrected. The maintainability factor of an incremental machine is reduced by some of the logical devices used in its design, usually centring about a greater use of timesharing. However, the degree of time-sharing employed can always be reduced at the cost of additional components. Also, additional equipment can be added to the basic incremental machine to provide improved error-detecting capabilities. But adding such equipment then leads to reduced reliability. The maintainability of an integral machine is adversely affected by its large number of components. On the other hand, it can provide elaborate checks on itself and the control system in which it is incorporated by the availability and relative ease of interpreting step-by-step operation, special programme control features, as, for example, a break point facility and diagnostic and test programmes.

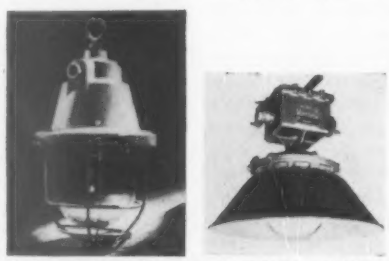
Industrial Lighting Fittings

Every advantage and facility, particularly from the point of view of economy have been designed into the new miniature fluorescent lighting fitting introduced by Victor Products (Wallsend) Limited, Wallsend-on-Tyne. The fittings are sold packed complete with the lamps fitted and operated. Fitting and servicing is particularly easy and isolation is possible as soon as the cover is opened. A spring clip holds the cover closed while the captive, key-operated fastening screw is being tightened—which leaves one hand free for the man on the ladder.

From left to right, the Victor weatherproof-flameproof shallow glass fitting; miniature fluorescent lighting fitting; and weatherproof-vapourproof 200 watt lighting fitting (single bolt lampglass housing)

Of particular interest to engineers in the oil and chemical trades for exposed and unprotected applications are the Victor weatherproof-flameproof lighting fittings. A new feature is the introduction of two types of Victor weatherproof-vapourproof 200 watt fittings for remotely dangerous areas. These take up to a 200 watt lamp and are of special design for ease of maintenance and quick re-lamping. One fitting (single bolt lampglass housing) has an ingenious yet simple action: the top casting has three small wedge shaped ramps which mate up with similar ramps on the lampglass housing and these are engaged and fully tightened by simply tightening up the draw-swing bolt.

The other fitting (toggle action lampglass housing) has a simple yet effective toggle mechanism with adjusting links whereby maximum pressure is achieved by the final movement of the toggle lever and resilience of the lampglass gasket giving a fully weatherproof and vapourproof sealing.



Left, weatherproof-vapourproof 200 watt lighting fitting (toggle action lampglass housing); and 125 watt flameproof lighting fitting and control gear for mercury discharge lamps

A further new product is the Victor 125 watt flameproof lighting fitting and control gear for mercury discharge lamps. It is designed primarily for use in mines under Group I conditions, but can be supplied for use under Group II where specially requested. The assembly consists of a robust pendant type wellglass lighting fitting connected to the control gear, housed in a separate enclosure mounted above the fitting. It is arranged with three-slot B.C. lampholder for mercury fluourescent discharge lamp type MBF/U.

Automatic Oil Burners

A new range of fully automatic oil burners designed for use with gas oil of 35 to 45 seconds viscosity Redwood No. 1 is announced by K. S. Burners Limited, 121 Crescent Lane, Clapham, London SW4. Five burners are included in the range varying from 50,000 to 1,100,000 Btu.

The specifications include a fuel pump with Sunstrand high pressure strainer and cut off valve; ignition transformer founded in plastic and mounted with the burner casting; pressed steel fan; silent flexible rubber type coupling; monarch 60° or 80° spray angle nozzle; and single phase 200/240 volts a.c. or 400 V three phase motor. Photo-electronic control can be supplied fitted to the burner.

Vanadium in Steel

One of the facts of metallurgy is that the Americans are greater addicts of vanadium in steel than the United Kingdom's steel manufacturers. However, there are signs that this situation is rapidly changing, and already there is talk of new British high speed steels with a relatively high proportion of vanadium in their composition which will take the place of some of the older steels. In the following notes some details are given of developments in the use of vanadium over the past four or five years.

MUCH of the dissatisfaction expressed in the past with vanadium as an alloying element in steel takes its origin from the fact that until recent times it was difficult to obtain vanadium metal of satisfactory purity. That position has been changed. It is now possible to obtain unalloyed vanadium with a characteristic composition as follows: carbon 0·06, oxygen 0·07, nitrogen 0·10, hydrogen 0·002%. An iron content of 0·005% is also included. Taking advantage of this fact, a complete survey was carried out some years ago of the 21 most important vanadium binary systems, designed to establish the phase relations, approximate terminal solubility limits, identities of intermediate phases, and the reactions between intermediate phases and terminal solid solutions. The elements forming the 21 binary systems with vanadium included beryllium, boron, carbon, nitrogen, oxygen, aluminium, silicon, titanium, chromium, iron, cobalt, nickel, copper, zirconium, columbium, molybdenum, silver, tin, tantalum. It will be appreciated that the complex data arising from these surveys are of considerable interest and importance to makers and users of steels alloyed with vanadium and one or other of the elements mentioned.

When about 0·07% of vanadium is added to ingots of steel from which quenched discs are made and tempered at 56° C, a higher tensile strength is obtained, which may amount to as much as 68 ton/sq in. and even higher (up to 76 ton/sq in.) for some compositions. The influence of the element on transverse ductility or transverse toughness of the quenched and tempered discs is, however, quite small.

It is known that contamination of vanadium with oxygen causes embrittlement at room temperature, and this raises a number of queries regarding the cold working properties. It appears from research to be necessary for better mechanical properties in vanadium alloys to be obtained by solid solution hardening, by cold working, and by age-hardening, in those instances where forging is possible in the region of the limit of solid solubility. Binary alloys of vanadium with titanium and zirconium show promise, and high strengths have been obtained with ternary alloys containing from 20 to 25% titanium and additions of one or other of the elements chromium, aluminium and silicon. Of these, aluminium is the best. Carbon up to 0·5% makes the alloy more forgeable, but has no great effect on mechanical properties.

These facts about the alloying element itself had to be ascertained before full understanding of some of its effects when introduced into steel could be known. The most important advance thereby rendered possible is the development of steels possessing a higher degree of ability to continue cutting at a red heat ('red hardness'). When vanadium is added in relatively high proportions (about 4·5%) to a tool steel containing cobalt, it produces a cutting material higher in both red hardness and abrasion resistance than the ordinary high speed steels. Highly alloyed tool steels of this type cannot be improved upon as long as a number of conditions are fulfilled. First, the steel must be protected against decarburization to the maximum degree when being subjected to heat-treatment, particularly if the machined surfaces are not to be ground after they have been hardened. Moreover, the new vanadium high speed steels are of lower ductility, and in consequence must be carefully protected against chatter at the tool nose or impact shock when at work. They present greater difficulty in being ground, and it is essential that the wheels used should be carefully chosen and the machine tools be of modern design and fully rigid. Otherwise they will prove so expensive in grinding and resharpening that their use will be less economical. If properly treated, however, cutting tools of cobalt-vanadium steel will give much longer service life.

The employment of vanadium as an alloying element in steel is designed in the first instance to elevate the temperature at which the steel begins to show an enlargement of the grain size, so that in effect it produces a more refined microstructure. Secondly, vanadium in steel has the effect of making it more hardenable, as long as certain conditions are fulfilled. The refinement of grain structure is caused by the ability of the element to form carbides. Vanadium also forms oxides and nitrides, and it is in considering the influence of these that the study of the binary vanadium systems becomes important.

Another effect of vanadium in steel is to reduce the degree of softening when the material is tempered, and to give to high speed tool steels and a number of other steels the ability to accept a secondary hardening. Examining the influence of vanadium in greater detail, we will take first the low carbon steels containing up to 0·1% carbon; research has indicated that the addition of vanadium first increases the hardness to a maximum value at about ·015% vanadium. Increase of the vanadium content up to about 4·5% by small increments first reduces the hardness to about 65 Rockwell B from 72 Rockwell B, then increases it to about 68 Rockwell B. These figures relate to the annealed condition.

Next, we must consider the medium carbon and high carbon steels. Assuming suitable heat-treatment, the following points will be noted. Quenched and tempered from 815° C in water or 540° C in air, a Vickers hardness of 302 will be given. The tensile strength will be of the order of 60 ton/sq in. Yield point will be about 49·5 ton/sq in. Yield-tensile ratio 0·821 psi. Elongation 18·3%. Reduction of area 54·1%. Izod impact 54 ft lb.

This explains the frequent American use of vanadium in steel castings, particularly when there are other alloys in the composition. One advantage of vanadium so used is that it eliminates hard spots caused by localized martensite, and thus renders the castings easier to machine. When steels have to be welded, the same effect is observed, because not only is the weld zone made less hard, but also brittleness in the zone is prevented.

Vanadium has other important effects. It is not only an active refiner of grain, but also a strong deoxidant. Small amounts of it in ferro-alloy form are sometimes added for this purpose to steels made by the Siemens acid open hearth process, particularly for railway use. Small amounts (0·1 to 0·2%) are similarly incorporated in the composition of some tool steels, chromium and chromium nickel steels. It is known to be one of the most effective of all scavengers for oxides.

In the older tool steels of high speed type, the vanadium content amounts to about 1·5%, but even as little as 0·5% produces a marked improvement in the cutting power of these steels. It was believed that once 2·0% vanadium had been exceeded, the resulting brittleness and hardness made it uneconomical to employ the steels; but this was in the days when less was known, and before the new machine tools, with their greater power and rigidity, came into being. Vanadium steels of high speed type harden in air much more effectively than steels without this element.

Vanadium has some use as an alloying element in alloy case-carburizing steels, but the amount introduced rarely exceeds 0·2%. Chromium vanadium steels contain from 0·15 to 0·18% vanadium, 0·8 to 1·1% chromium and carbon ranging from 0·1 to 1·05% The alloy steels of this type containing carbon up to 0·25% are employed for carburized parts. The medium qualities with 0·45 to 0·55% may be employed for leaf and small coil springs. The qualities with higher carbon still can be used for balls and ball bearings as well as tool steels.

Vanadium has a number of special effects not hitherto discussed. It increases the endurance limit and the ratio of endurance limit to tensile strength not only in steels extremely low in carbon, but also in medium carbon steels and constructional steels with moderately high carbon. Many steels possess high endurance properties only if they have first been quenched and tempered, but carbon steels alloyed with vanadium have endurance ratios of approximately 50% when normalized and tempered, while medium carbon manganese vanadium steel particularly intended for large sections has an endurance ratio of 55 to more than 60% in the normalized and tempered state. These uniformly high endurance ratios are largely caused by the typical uniformity of microstructure and composition of the vanadium steels.

Vanadium has some slight influence on the oxidation of steels at high temperatures, which it tends to delay to a slight degree. It is more important, however, that vanadium steels form a scale which is readily removed and defined, and this is useful in the economical forging and hot rolling of the material.

The element can also be employed to produce resistance to age-hardening in low carbon rimming steels, without sacrificing their advantages. The element is added to the extent of about 0·05%, and the tensile strength strength is afterwards found to be about 17 ton/sq in. at 200° C as compared to 20 ton sq in.

When added to the composition of the stainless steels, vanadium to the extent of about 0·5% definitely improves the ability of a 14% chromium steel to be worked in a number of ways. There is some slight increase in ductility of the 18–8 austenitic stainless steels when vanadium is added, but this is not important. Used in the proper proportions, vanadium will also increase the resistance of these austenitic steels to intergranular corrosion, which effect it achieves by stabilizing the carbides. In low alloy steels, however, while vanadium does slightly delay corrosion, the effect is not great enough to have any commercial significance.

In proportions up to 1·5%, vanadium is often used in steel for special heat resistance, and this brings us to another important attribute of the element. In conjunction with molybdenum and/or tungsten, it has a notable influence on the resistance of a steel to creep. In a steel having a carbon content of 0·37% the addition of 0·18% vanadium has the following effect. Assuming a load of about 5 ton/sq in., the rate of deformation at 500 hr is approx. 0·00006%/hr, and the average total deformation after 500 hr is approx. 0·120%. An unalloyed carbon steel has an average total deformation under the same conditions of about 0·5231%.

Vanadium is a useful alloy in nitriding steels and steels for wearing plates. Stabilization of the fine grain structure by vanadium in austenitized steels means that the steels retain their high ductility and impact resistance during the development of high tensile and yield strength. Vanadium widens the range of temperature within which pearlitic steels can be hardened, while still remaining within well-defined values. The upper limit is not so high as to make grain enlargement in advance of machining difficult, when the steel is normalized at moderate temperatures with later restoration of the fine grain structure by normal methods of heat treatment. In carburizing operations at the normal temperatures, steels containing vanadium keep their fine grain, and acquire high strength, with no decline in ductility and resistance to impact, if quenched immediately from the carburizing box.

Vanadium also delays the softening usually brought about by the tempering of martensitic structures, and is believed to be more effective in this respect than any other element.

In short, vanadium is a most useful alloying element in steel, and one whose importance is rapidly growing.

Ultra High-strength Steels

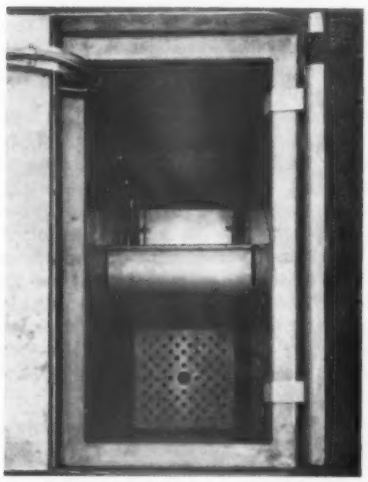
A new series of ultra high-strength steels, designed to give tensile strengths of between 100 and 140 ton per sq. in. after tempering at up to 600° C, has been developed by Samuel Fox and Company Limited, a subsidiary of the United Steel Companies Limited, Sheffield.

At present there are three steels in the series, one of these HST100, formerly called Fox 769, is already in production and gives 100 ton tensile strength in the air-hardened and tempered condition. The others, HST120 and HST140, have been obtained by small compositional changes in the basic HST100 analysis without increase in the carbon content. They have tensile strengths of 120 and 140 ton per sq. in. respectively at room temperature. The carbon content of HST 120 has been reduced to 0·30% and both steels can be hardened in either air or oil depending on mass; all three have silicon contents below 0·40%.

The HST steels can be produced in the form of billets, blooms and slabs for forging and re-rolling, and in bars for forging or machining. Experiments are taking place to produce sheets down to 0·064 in. thick.

Degreasing Plants for Ultrasonic Cleaning

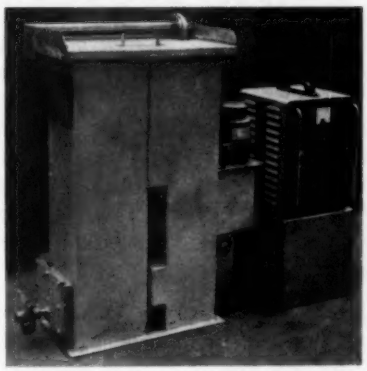
A series of ultrasonic cleaning plants designed for use with trichloroethylene is being marketed by Imperial Chemical Industries Limited, Millbank, London SW1. The smallest and simplest of these is the ULV1 (compartment size 9 in. × 7 in. × 7 in. deep). Ultrasonic generating equipment, made by Dawe Instruments Limited, 99 Uxbridge Road, London W5, is connected to a sealed stainless steel transducer unit containing barium titanate elements submerged in cool trichloroethylene in one compartment of the plant. Here, electrical impulses at a frequency of 40 kc/s are changed to mechanical vibrations which produce cavitation in the solvent. Cavitation means the alternate formation and violent collapse, at a very high rate, of minute cavities in the liquid, giving an intense scouring action at the surfaces of the work. The high solvent power of trichloroethylene on oil and grease contamination is assisted by the mechanical effect of the scouring, so that insoluble solid particles are effectively detached,



The ULV1 ultrasonic cleaning plant from above, showing the ultrasonic and boiling liquor compartments

even from cracks and pits on metal surfaces. The solvent in the cleaning compartment is circulated by a pump through a filter, where solids are collected, and back to the same compartment. The filter is easily accessible for renewal.

The other compartment holds electrically heated boiling trichloroethylene below a vapour layer.



The ULV1 ultrasonic cleaning plant from the front. The pump and filter for collecting solids from the ultrasonic computer can be seen respectively above and below the projection on the right of the plant

Vapour rises to the condensing coils, falls as liquid into the ultrasonic compartment and returns to the boiling liquor compartment by overflowing the weir plate. A water coil prevents the temperature in the ultrasonic compartment from rising above 60° C and damaging the transducers.

The route of articles through the plant varies according to their condition. Most of the work for which the ULV1 is appropriate is not heavily greased or oiled and can go straight into the ultrasonic cleaning compartment, and then into the vapour above the boiling liquor. Grossly contaminated work should be given a preliminary dip in boiling liquor; in the larger plants three compartments are provided so that a steady flow of work can be maintained. The final immersion in vapour is desirable for safety and economy, as it ensures that work is dry when it leaves the plant.

Safety features include rim ventilation equipment and a thermostat which cuts off the heat if the water fails or if the solvent level falls dangerously low.

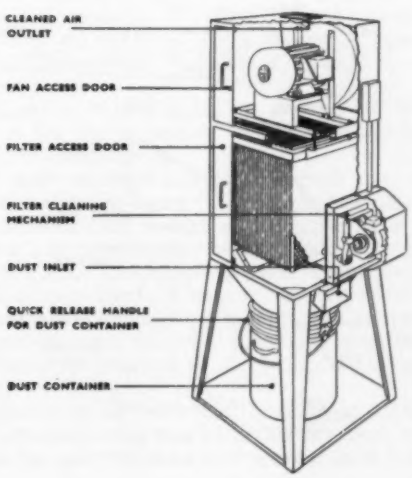
Dust Collector Unit

A new dust collector, the Unimaster, is completely self-contained and compact and has a built-in fan which handles cleaned air only and discharges upwards to avoid draughts. An improved fabric filter element of patented design is used with a variety of fabric materials available to suit the dust being handled.

An 'air cushion' filter cleaner (British and Foreign patents pending) is motor driven and there is push button control for fan and filter cleaning mechanism: completely automatic cleaning is also available. There is a quick release sealing gear for easy removal of dust container, the latter being available in alternative sizes. The inspection doors to fan, motor and filter are flush fitting and dust inlet connexion openings are available on three sides of the collector with one inlet spigot as standard.

The new collector is initially available in the 70 series (70 sq ft of filter cloth area), fan capacity range 0 cfm at 6·2 in. w.g. to 765 cfm at 3·3 in. w.g. A complete range extending up to 250 sq ft of filter cloth area in a single unit will be available shortly. The collector is made by Dallow Lambert & Co. Limited, Thurmaston, Leicester.

Unimaster self-contained built-in fan



The Scope of Flaw Detection

The days when sample, or suspect, castings, etc., had to be cut up and destroyed in checking for blowholes or other internal defects have passed—nor are methods of destructive testing good economics under present production conditions. Non-destructive flaw testing techniques have developed from the radiograph to embrace fluoroscopy, now available as a practical industrial technique, and ultrasonic testing which lends itself, in particular, to fully automatic operation if necessary. Magnetic particle testing, however, still retains its place and all four methods are evaluated in this article.

MODERN techniques developed specifically to provide non-destructive methods of flaw detection are based around five different methods—the use of X-rays (and gamma rays) for 'pictorial' presentation; the more recent development of fluoroscopic techniques to a point where this method can now compare in sensitivity with X-ray detection; magnetic particle testing; eddy-current testing and the application of ultrasonics as a method of probing and investigating internal masses on an 'echo' basis. The latter, in particular, lends itself to fully automatic flaw detection systems with monitoring control adapted to specific requirements.

X-ray detection is logical in principle, capable of good sensitivity and well established as a practical method of engineering testing, although relatively costly and not a rapid process. Radiations emitted by the X-ray tube, too, represent a hazard which must be properly guarded against. Scattered radiation may also affect the photographic film to give false images or fogging—more generally a reduction in necessary contrast on the true image. These are features normally controlled by proper attention to detail design of the complete apparatus, or the use of special filters in the primary beam. Modern industrial X-ray equipment represents substantial advances in these respects, particularly on contrast achieved.

The principle of X-ray analysis or radiography is that the penetrative power of X-rays enables them to pass through a considerable thickness of most materials, their path effective like that of light rays through a transparent medium. Radiations are, however, absorbed by the medium traversed—uniformly if the material is homogeneous, but with different degrees of absorption through regions of non-homogeneity.

The presence of a cavity in the path of the X-rays, for example, represents a reduction in thickness of material traversed, hence the emergent rays are more intense at a corresponding point, resulting in a darker patch on the film negative. Thus the lateral extent of an internal flaw is detectable from the shadow pattern produced. The actual *thickness* of the defect can also be evaluated on the basis of the *density* of blackening of the negative.

The image offered by the radiograph—which term refers to the exposed and developed film—is essentially a shadowgraph or shadow picture and as such subject to certain practical limitations. The sharpness or definition of the image is largely dependent on the amount of penumbra shadow present—it being a practical impossibility to produce an absolutely parallel beam of X-rays, hence both an umbra and penumbra shadow is cast on the radiograph—Fig. 1. This is controllable to a large extent by the geometry involved although the factors producing a minimum width of penumbra—e.g. increasing the distance of the X-ray source from the object under examination—is not always consistent with intensity requirements. Thus specific positioning may be specified for different catagories of examination. Good definition is particularly important where contrast differences have to be evaluated by eye, although the actual contrast achieved is largely dependent on the film type, exposure time and development and the character of the apparatus. As far as the eye is concerned, the greater the amount of penumbra shadow present, the more difficult it is to differentiate between different degrees of contrast. In any case, accurate interpretation of the shadowgraph is essentially a job for a skilled

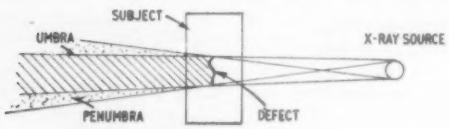


Fig. 1 (top left).—Penumbra shadow on radiograph must be controlled for adequate definition

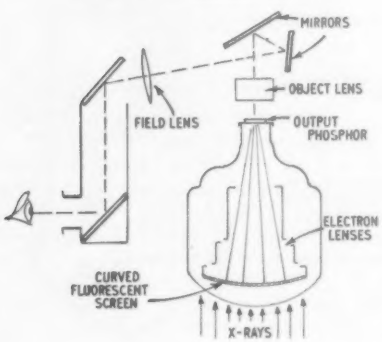


Fig. 2 (bottom left).—Diagrammatic representation of image intensifier optics

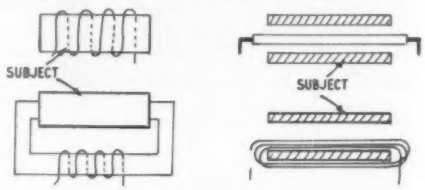


Fig. 3 (top right).—Four alternative methods of magnetizing subject with heavy guage conductors. Currents may be very heavy, according to field coverage required

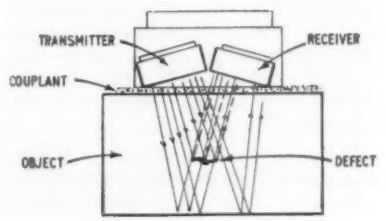


Fig. 4 (bottom right).—Diagrammatic representation of ultrasonic flaw detector

operator who has learnt to 'read' the shadowgraph through experience, as well as produce a radiograph in the first place capable of giving him the degree of shadow detail required.

In fluoroscopic technique the X-ray 'negative' image is rendered as a 'positive' or reversed shadow on a suitable fluorescent screen which can be viewed directly. The normal dark patches associated with a defect on a radiograph now become bright patches and interpretation is in the opposite sense.

The whole apparatus can be rendered in the form of a completely self-contained unit with complete protection afforded by a lead-lined cabinet so that it can be used anywhere, without special precautions. The low level of illumination characteristic of the fluorescent screen can also be overcome by employing an electronic image intensifier with a special screen—see Fig. 2. The other comparatively recent developments in this field have been concerned with bringing the sensitivity of the fluoroscope up to a level comparable with radiography—a point which has now been reached. Another original defect which the image-intensifier has eliminated is that to obtain brightness with an ordinary screen both the thickness of the screen and grain size must be increased, with loss of definition. The electronic image intensifier works on the principle of brightening the weaker, sharper image on the thinner, fine grain screen and thus preserves a sharp image.

Since the fluoroscope embraces a complete X-ray unit as a basis the same machine can also be adaptable for taking radiographs direct. In other words it can become a dual-purpose machine, with fluoroscopic viewing for rapid, visual examination or for the production of radiographs for more detailed examination, or for record purposes. As such, this class of machine now represents a most attractive method of non-destructive testing applicable throughout a wide range of industries.

The considerably cheaper and simpler method of non-destructive testing with magnetic particles has definite limitations but is by no means redundant. It is particularly suitable for detecting surface cracks and defects, with the advantage of being rapid in operation although it is essentially limited to ferro-magnetic subjects. It is not so good for detecting internal defects, although again it is more convenient to use in the examination of, say, large and heavy castings. Ideally, magnetic particle testing for surface defects and radiographic methods of internal inspection provide a complete survey.

The basis of the magnetic particle test is simply that the part under test is temporarily magnetized and then dusted with a powder of very finely divided iron (or immersed in a suitable liquid containing the iron particles in suspension). Any flaws present in the magnetized subject represent discontinuities, with the tendency to form subsidiary magnetic poles and a distorted flux field. The object of the iron particles offered to the subject is to trace the pattern of leakage flux and thus provide a 'plot' of the external field and any discontinuities which may be present.—Fig. 3.

In fact, ferro-magnetic materials are characterized by high permeability, whilst cracks, blow holes, etc., offering an air path have low permeability and hence set up a resistance to the passage of the magnetic flux. This 'resistance' is translated in terms of a deformation of the flux lines around the area of low permeability. If the defect is at or sufficiently near to the surface the distorted, bridging flux lines will leave the material, entering again on the other side of the defect. In such a case a magnetic pole will be set up on the surface where the flux lines leave, and also where they enter again. Iron particles in the immediate vicinity will thus be strongly attracted to the surface and align themselves consistent with this external magnetic field, clearly indicating the area of magnetic flux discontinuity.

A practical limitation arises in that some discontinuities may inherently arise due to the geometry, surface finish and magnetic characteristics of the subject, as well as through variations in the process of magnetizing the subject. Thus every external magnetic field plotted by the iron powder is not necessarily a mechanical defect in the practical sense of the investigation, and correct interpretation of the powder pattern is largely based on experience, consistent with the choice of the best technique and optimum presentation of the subject for magnetization.

The method is in widespread use and can give very satisfactory results when properly applied. Both 'wet' and 'dry' methods are employed (the fluid in the former case usually having a petroleum-base) and there are no convincing conclusions as to which gives the better overall results. The 'wet' method is generally regarded as being the more sensitive, especially on finely finished surfaces; with the 'dry' powder method generally preferred for rougher surfaces where liquid suspensions may tend to give false patterns through drainage effects.

Non-destructive testing by means of eddy-currents, although known as a theoretical possibility for a considerable number of years, has only recently come into prominence as a practical industrial method. Even now it is sufficiently new as to be largely undeveloped beyond a number of limited applications. Its main limitation, apart from difficulty of 'reading' through suitable instrumentation, is that it is suitable only for the inspection of uniform products of simple geometry. It has the advantage over magnetic particle testing, however, in that it can be applied to non-ferromagnetic metals.

The theory of eddy-current flaw detection is similar to that of magnetic particle testing. The regular flow pattern of eddy currents generated within the mass is disrupted at discontinuities. Essentially the test instrument consists of a coil or wire excited by an alternating current which is placed in close proximity to the object to be tested. Eddy currents produced in the material alter the effective impedance of the coil, which is measured and deviations from a standard field pattern are evidence of discontinuities. In practice, discrimination is usually based on detecting the phase difference between voltages from a bridge circuit, relative to readings obtained from a standard test piece.

Main application of eddy-current testing, at the present time is for the inspection of bar and tubular stock of uniform cross section.

Ultrasonic flaw detection methods operate on an entirely different principle again. The basis is essentially similar to 'echo sounding' in that a penetrative wave is projected from a transmitter through a medium to be reflected at a boundary and picked up again at a receiver. Reflexion will also be received from any discontinuity—see Fig. 4—which will represent a shorter time interval between transmission and reception and from this time-interval difference the position of the discontinuity can be determined.

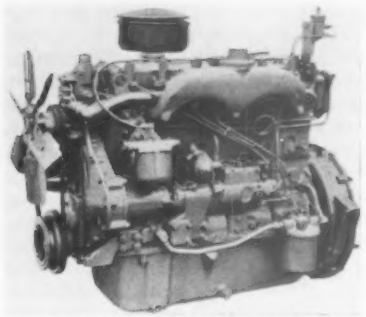
Since the velocity of the wave is of the order of 20,000 fps in steel, obviously the time intervals involved are minute. Hence the use of electronics is essential in such an

instrument and a cathode ray oscilloscope the logical method of presenting the readings.

The transmitter is invariably a piezo-electric crystal (usually barium titanate) driven by an oscillator, whilst a similar transducer is employed for the receiver. A single transducer may perform both functions (i.e. act both as the transmitter and receiver), or transmitter and receiver crystals may be separate, either in separate mountings or in separate Perspex blocks in a single casing. Transmitter frequencies employed may range from 0·5 megacycles/sec up to 10 megacycles/sec, depending on the material and subject to be investigated. A basic requirement in this respect is that the wavelength should not be greater than the dimensions of the flaws to be detected.

Practical considerations concerned with the application of the ultrasonic flaw detector are that there must be good acoustical contact between the probes (transmitter and receiver) and the surface of the object under test. This can be provided with a film of suitable couplant (either applied to the test object surface or poured between a small gap between the probe and surface to maintain a complete bridge); or by immersing both probe and object in a suitable fluid (usually water). All have the same effect in that a homogeneous couplant is provided between the probe and surface of the object under test.

Resolution is largely dependent on the electronics involved, also the form of the transmitted beam. High sensitivity for the detection of small flaws, etc., generally demands a beam of constricted width—normally called a pencil beam—whilst for more rapid inspection a divergent beam may be employed with correspondingly reduced sensitivity. Additionally, too, ultrasonic waves may be generated transversely and in the form of surface waves, if specifically required.



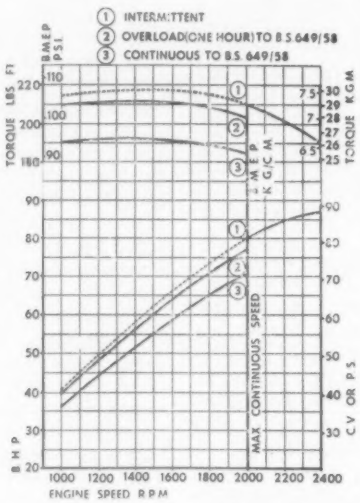
Perkins Six 305 industrial diesel engine

New Industrial Diesel

A new five litre, six cylinder industrial diesel engine suitable for many different applications, including tractor shovels, fork lift trucks and mobile cranes, has been introduced by Perkins Engines Limited, Peterborough. Named the Six 305(I), it is rated up to 87 bhp at 2400 rpm for intermittent use and is fitted with chrome-plated thin wall liners to reduce bore wear when the engine is used under dusty, adverse conditions.

Fitted with a compact flange-mounted distributor-type fuel pump, the new engine can be equipped with either a hydraulic governor for types of industrial equipment requiring engine speeds in excess of 2000 rpm or a mechanical governor for applications such as generating and pumping sets, needing close governing.

The engine will be available with a wide selection of flywheels and flywheel housings to suit various applications, and also in stage-by-stage form up to a complete power pack. It has a 3·6 in. (91·44 mm) bore, a 5 in. (127 mm) stroke and 305·3 in. (5 litre) cubic capacity, and



The Six 305 diesel engine ratings

a seven bearing crankshaft forged from chrome molybdenum steel. The front end is serrated to transmit power up to maximum engine torque for a direct coupled power take-off requirement, such as a hydraulic pump.

Draw-out Centralized Motor Control Gear

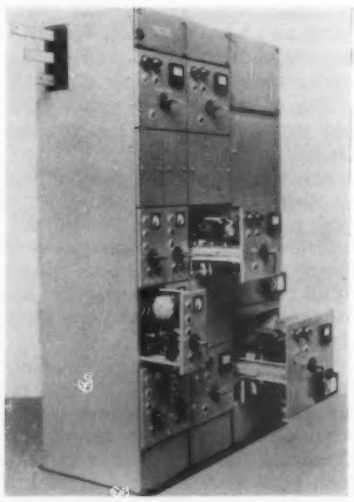
There are a number of advantages to be gained from grouping together all the starters for the motors of a complete process line or section of a factory. Supervision and maintenance are facilitated, cabling and installation costs are frequently reduced, and by suitable design of the equipment much space can be saved.

Prior to the introduction of standardized equipment, multi-panel arrangements usually had to be specially designed for each requirement and were, therefore, costly and manufacturing time was long.

The draw-out equipment made by Laurence Scott & Electromotors Limited, Norwich, combines the advantage of standardization, together with the flexibility of design which enables a wide range of requirements to be met promptly and economically.

The draw-out principle enables a drawer (containing the actual motor starting and protecting equipment) to be isolated from the bus-bars and drawn out to stops, merely by release of one handle. If further maintenance work is required the drawer can be removed completely to a bench.

Standard units include sizes up to approximately 12½, 35 and 90 hp and these can be assembled in various combinations. There are also facilities for incoming supply cables, outgoing cables to other cubicles, special panels, etc.



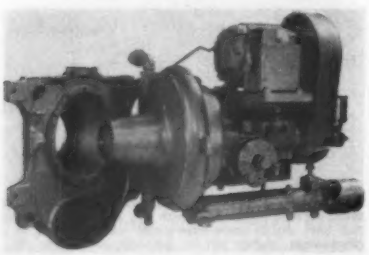
L. S. E. centralized draw-out motor control gear has been ASTA-tested to 35 MVA

INDUCED ROLL SEPARATOR.—This high intensity magnetic separator (type MJ) made by Rapid Magnetic Limited, Lombard Street, Birmingham, has a high throughput coupled with high efficiency. It is used for the purification of silica sand, abrasives, slag, etc., and the concentration of ilmenite, monazite, tantalite, etc.

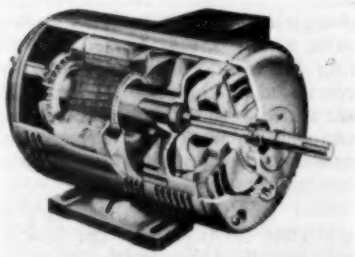
Gas and Oil Burner

This burner which is a combination unit designed to burn either oil or gas has been introduced by Hamworthy Engineering Limited, Poole, Dorset. The burner incorporates a built-in gas manifold and gas firing nozzle. With this arrangement the same mechanism that is used to ensure the proper air/oil mixture is employed in the burning of gas with the same resultant high combustion efficiency.

The unit has the advantage of being able to burn the heavier fuel oils available and at the same time modulate the output to meet the exact steam on hot water requirements, thus the operating costs are kept to a minimum and labour costs are neglible. Another feature—and one emphasized by the Clean Air Act—is the smoke free operation which can be obtained. The burner operates on the rotary cup principle of atomization with the correct amount of fuel being fed to the rotating cup through a series of metering devices. Primary air for atomization is supplied by a fan in the burner and is controlled by an air shutter over slots in the fan intake. Secondary air is from a forced draught fan of the axial flow type, which is normally mounted below the burner on a windbox casing. Other equipment includes a low density heater, ignition equipment and flame failure control equipment. All the automatic control gear is contained in a factory wired and tested control panel which is normally wall mounted adjacent to the boiler. Various sizes of the rotary burner are made for boiler outputs between 80,000 to 19,000,000 Btu's.



Combined gas and oil burner. The burner is open to show the gas inlet (bottom left)

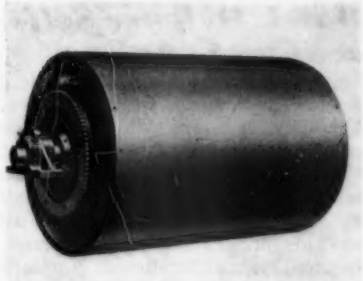


Capable of infinitely variable speed over a wide range, the fractional horse-power Dynamatic Ajusto-Spede drive has a housing diameter of 6½ in. and a length of only 15½ in. It is designed for use with a.c. mains

Combined Motor/Coupling Unit

A new combined motor/coupling unit, capable of giving infinitely variable speeds over a wide range, and suitable for duties of up to a nominal two horsepower, has been introduced by Heenan & Froude Limited, Worcester. The new unit, the Dynamatic Ajusto-Spede drive (model ACM 903) is an integral combination of a quill-mounted, squirrel cage motor and an air-cooled eddy-current coupling mounted in a common housing. The absence of any moving electrical contacts or vulnerable rotating components assures a long operating life and the minimum of maintenance. A small, built-in tachometer generator provides a speed-sensing signal for accurate, feed-back type speed control.

Various types of low voltage control gear are available for use with this drive to provide the numerous characteristics, such as tension control, acceleration control and synchronization, which are often required by special purpose machines.

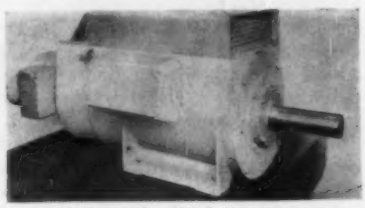


TRAMP IRON DIVERTERS.—The range of tramp iron diverters made by Rapid Magnetic Limited, Lombard Street, Birmingham 12, has been extended to cover burdens beyond the capacity of conventional pulley and pulley type separators. A typical unit for the recovery of iron bearing slag is 42 in. dia, 60 in. wide and weighs about 6½ ton. High temperature class-B insulation is used throughout to cater for the treatment of hot slag, whilst the drum cover is of substantial thickness of stainless steel provided with expendable outer covers

New Induction Motors

A new range of induction motors designated Type NC for squirrel cage and Type NW for slipring machines has been introduced by the motor and control divisions of Associated Electrical Industries Limited, Rugby. Rated from 8 to 285 hp these machines, which have Class-E insulation with 650° C temperature rise, will replace part of the existing range of motors with Class-A insulation.

The company's range of new KN-D electric motors has been extended from 7½ hp to 40 hp at 1500 rpm. These totally-enclosed, fan-cooled machines, now available from stock, comply electrically with British Standard 2613:1957 and are dimensionally in accordance with draft British Standard (A(ELE) 1629). This makes them interchangeable, rating for rating, with AEI drip-proof motors, Type KN-C, built in accordance with British Standard 2960:1958. Type KN-D motors have Class-E insulation with 65°C temperature rise. The use of improved insulation has made it possible to offer a motor of smaller dimensions to replace the earlier machine with Class-A insulation and 55°C temperature rise.

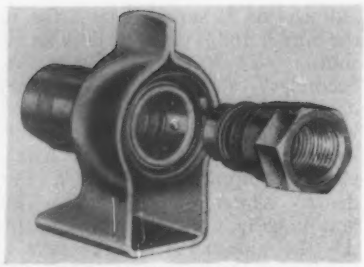


A.E.I. Type NW slipring induction motor

Quick Release Self-sealing Coupling

Super Oil Seals and Gaskets Limited, Kings Norton, Birmingham, announce an addition to their range of Aeroquip flexible hose and end fittings. This is a new quick release self-sealing coupling for use in all hydraulic feed lines of up to 3000 psi working pressure. It is being manufactured with either British standard or American threads, and, by the use of adaptors supplied as required, is available in two sizes namely $\frac{3}{8}$ in. and $\frac{1}{2}$ in.

The coupling is designed for use on both general industrial and agricultural equipment and for the latter type of application a mounting bracket is supplied which enables the coupling to be fixed to a tractor or some other towing vehicle. When so installed, one half of the coupling is held by the bracket but the other half is free to disengage automatically should an unexpected pull be applied to the hose line. In this way, both hose and coupling are safeguarded from accidental damage. Used with or without the "breakaway" bracket, the coupling is self-sealing on disconnexion.

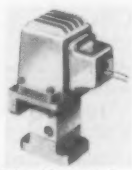


Quick release self-sealing coupling with breakaway bracket. When used in conjunction with bracket, one half of coupling is held fast, whilst the other half can automatically disconnect should any unexpected pull be applied to the feed line

Simple in construction, the coupling consists of two halves each using a spring loaded poppet sealing valve and a spring loaded thimble ring for quick attachment. When connected, the halves of the coupling are sealed with a rubber sealing ring and held in position by a series of hardened steel balls working in tapered location holes.

Test results show that there is negligible restriction to the flow of hydraulic fluid through the coupling.

Hand lever operated co-axial poppet valve



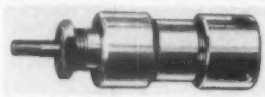
Solenoid operated co-axial poppet valve

Air Valves and Cylinders

New air cylinders or actuators, new solenoid operated control valves, and new co-axial poppet valves have been added to the range of pneumatic equipment made by Air Automation, 26 Sharrocks Street, Wolverhampton.

The "Airmatic Minor" air cylinders or actuators are in 1 in. and $1\frac{1}{2}$ in. bore sizes, are of non-ferrous construction, with stainless steel piston rods, and have screwed nose mounting and rear trunnion mounting. Synthetic rubber seals (not O-rings) on a non-ferrous piston are used, and the series is available in single and double acting non-cushioned patterns. End caps are round instead of hexagonal, so the cylinders can be fixed in the minimum possible space.

The new solenoid operated air control valve is of continuously rated high duty pattern with shock mountings in both directions, tool



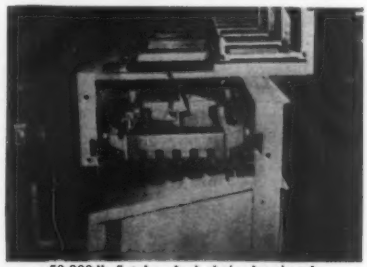
"Airmatic Minor" cylinder

steel pads to plungers, silicon grain orientated steel laminations wound with Lewmex and insulated with varnished glass fibre, and with guides of beryllium copper. The valve is directly operated, not through a pilot orifice and air flows of 35 cfm may be obtained without using the valve to pilot-operate a larger valve. Where it is used as a pilot valve the high air flow means that very remote mounting is permissible. Three and four way patterns are available, the latter in both spring return or double solenoid operated types.

The new co-axial poppet valve can be for manual, foot, pilot or solenoid actuation. It is similar in appearance to the conventional piston valve, but internal seals to line and cylinder are of poppet type, giving absolutely positive seal with the minimum of friction. Operation is effected by light pressure making the design especially suitable for spring return or solenoid actuation, and no leakage can develop due to the valve wearing in. The lever operated valve can have a pilot operated safety locking device, where two handed operation is required. The range covers 3- and 4-way patterns, with either $\frac{1}{4}$ in. or $\frac{3}{4}$ in. BSP port tappings.

Tube Drawbenches

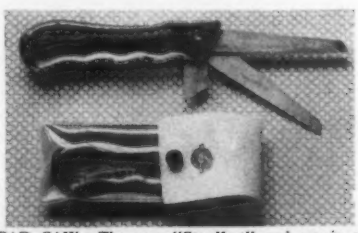
An agreement has recently been completed between The Lombard Corporation of Youngstown, Ohio, U.S.A. and Reed Brothers (Engineering) Limited, Replant Works, Woolwich Industrial Estate, London SE18, whereby the latter company will sell and manufacture the complete range of Lombard mechanical and hydraulic drawbenches in Great Britain.



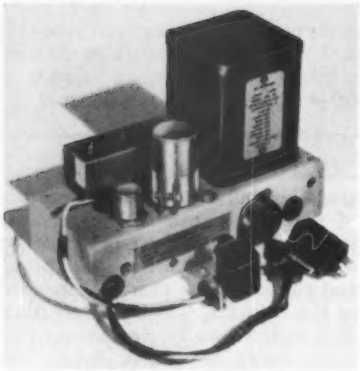
50,000 lb 5 tube, dual chain drawbench

The Reed-Lombard range embraces single, triple and five tube type mechanical benches from 10,000 lb to 200,000 lb and hydraulic benches from 10,000 lb to 350,000 lb. The pinch roll design for five tube drawbenches features two continuous motor driven top rolls and five individually air cylinder operated double bottom rolls. Each bottom roll is disengaged as soon as its tube is driven completely on the mandrel.

A feature of the mechanical benches is that chain hooks and gripper jaws on draw carriages are air operated and tubes are drawn 6 in. before air pressure is released. The draw carriage never touches the die stand and dual chains are positioned to apply force on the centre line of draw, thus eliminating the pick-up and drop characteristics of single chain benches.



PAD SAW.—The new "Steadfast" pad saw is a multi-purpose pocket tool with two saw blades, coarse and fine, and a knife edge cutter all contained in a translucent amber plastic grip-shaped handle. The retail price is 6/- and replacement blades cost 3/- for a set of three. The makers are J. Stead & Co. Limited, Cricket Inn Road, Sheffield 2



Kent Type 3 reference unit

Electronic Control Instrument

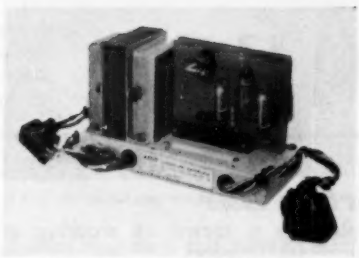
Two new Kent electronic instruments are a constant-voltage source or reference unit, and a transistorized quadrature suppressor for the Kent a.c. servo system.

The reference unit, designated Type 3, is a completely new solid-state d.c. reference source designed, developed and produced by George Kent Limited of Luton, Beds., England, for use with the company's range of electronic self-balancing recorders, indicators and controllers. A compact plug-in assembly operating directly from the normal a.c. mains supply, it provides an extremely stable, ripple-free output of 5·0 mA at 5V for the slidewire of the instrument measuring circuit.

Two Zener-diode stages in cascade reduce the effects of normal supply variations by a factor of at least 200, while individual temperature compensation of each of these stages ensures that the output is substantially independent of changes in ambient temperature between 10° and 70°C. An inherent advantage is that the unit continues to operate with only slightly reduced accuracy if the supply voltage is drastically reduced, even to as little as 30% of its nominal value.

The d.c. output is isolated from earth, and a specially screened and balanced mains transformer effectively isolates it from the mains supply. This feature is of great value in certain measuring circuits having a finite impedance to earth.

The exclusive use of solid-state components together with a very simple circuit configuration results in a rugged unit possessing a high degree of reliability. It is noteworthy that the only electrolytic capacitor employed is of the "super-quality" type, specially developed for applications where extremely long life is essential.



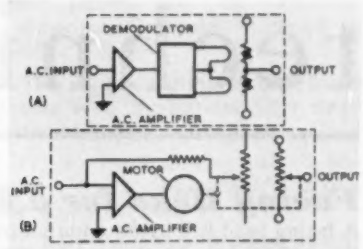
Kent Type 1 Quadrature Suppressor

Among the many advantages resulting from the use of the Type 3 reference unit are enhanced instrument performance; increased reliability; fewer components (no standard cell, synchronous converter, etc.).

The new suppressor is a small plug-in electronic assembly which eliminates the possibility of amplifier saturation and errors in measurement arising as a result of the presence of a quadrature component in the input signal. A high degree of reliability and robustness is achieved by using only transistors, thermistors and other solid-state components. The principal part of the suppressor is the Kent-patented thermistor potentiometer, which comprises a plug-in printed-circuit carrying the main components. These are collectively comparable to the amplifier, balancing motor and slidewire of a conventional servo system.

The new unit effectively combats the quadrature effects that frequently occur in a.c. servo systems such as those measuring the electrolytic conductivity or the rate of flow of liquids. These spurious signals can have very detrimental effects, for any quadrature components present in the input of an a.c. servo system cannot be reduced to zero by the main a.c. feedback, and give rise to an irreducible error signal. This in turn may cause an error in the output of the system or may cause partial or even complete saturation of the amplifier and resultant loss of sensitivity.

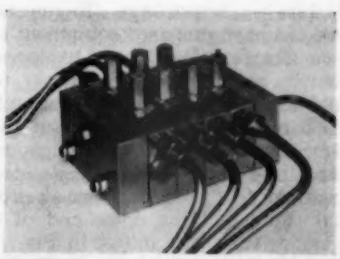
The Type 1 quadrature suppressor provides a solution to the problem by applying an automatic cancelling action to any incoming quadrature components, whether stable in magnitude or not, while in no way interfering with the main input signal. The residual quadrature error signal, derived from the servo amplifier, is amplified and demodulated by a circuit containing four low-power germanium transistors and used to control differentially the power supplied to the heaters of two indirect-heated thermistors. The two thermistor beads form a voltage divider of variable gain controlling a signal of precise quadrature phase (derived by a 90° shift from the a.c. reference) which is fed back to the input of the servo amplifier and suppressess the residual signal. The circuit is direct-coupled from end to end and a third thermistor provides over-all negative d.c. feedback from the output to the input. This stabilizes the operating points of all four transistors without the use of any capacitors, and maintains the output characteristics of the thermistor potentiometer substantially constant in ambient temperatures between 0° and 60°C.



Kent transistorized Thermistor Potentiometer (A) is equivalent to a servo-driven mechanical-slidewire assembly (B)

Lubrication Indicator

A new "trouble" indicator for use with the Exactor-Trabon centralized grease and lubricating systems, has been introduced by Exactor Limited, Church Way, Edgware, Middlesex. The indicator, available for operating pressures of 250 to 2500 psi, pinpoints any blocked line condition occurring in the lubrication system. Central visual or audible warning devices alert the operator, who can locate the trouble by merely checking the indicators.



The new Exactor Trabon reset indicator pin points any blockage stopping the flow of lubricant to the bearings, and then automatically resets when the line is cleared

technique

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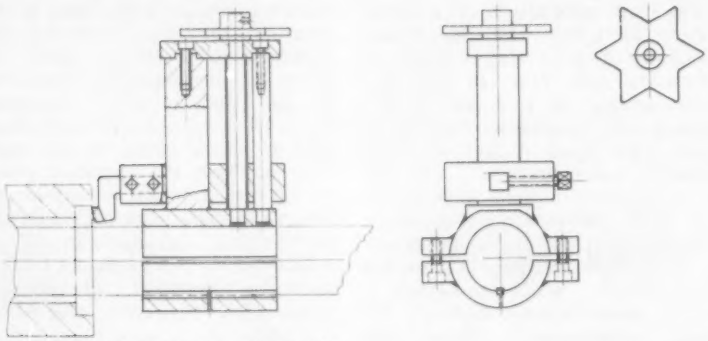
Facing Head for a Boring Bar

A facing head is a useful addition to the boring bar. In the one shown here the rotating bar is secured to a lathe faceplate and supported at the tailstock end, and this makes a site for two half clamps of welded construction attached to which is a long rod which acts as the main guide for the tool bar. A long screw inserted in the top cap and anchored at the other end by a plate is turned by the star wheel. The star wheel is held by a small grub screw.



Facing attachment for boring bar which enables additional machining to be done at one setting

A rear supporting rod assists in holding the top plate correctly in relation to the holes bored in the cap. Both the main shaft and rear support are recessed into this upper plate as a means of securing an accurate location.

A cranked tool is useful with this equipment because it enables a small facing to be machined close up to the bar and by reversing the tool in the holder a larger facing is covered.

The feed is one sixth of the pitch of the screw, so a screw $\frac{3}{4}$ in. dia and of 24 tpi having a pitch of 0·042 in. which will give a feed of 0·007 in. for for each revolution, which is reasonable for the average run of work.

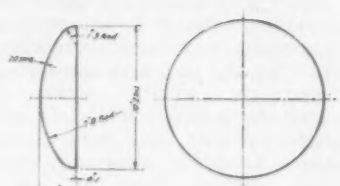
The unit is clamped to the rotating bar with six screws but it is not advisable to rely on this grip for driving so a key is inserted in the lower cap and this fits tightly into a slot machined in the bar.

High-speed Forming of Metal Plates

Three new methods for the high-speed forming of metal plate have been receiving attention recently. They involve the use of high explosives, compressed air, and the underwater discharge of a high-voltage spark. In order to obtain information on the first-named method Vickers - Armstrongs (Engineers) Limited have prepared equipment at their Crayford Works and explosive charges at their Thames Works to enable experiments to be carried out.

To minimize expense, and at the same time to make the investigation as realistic as possible, it was decided to attempt to produce a one-twelfth scale model of the dome end of a pressure vessel, as shown in Fig. 1. The blanks used, were of 20 swg (0·036 in.) bright mild steel plate, and the high explosive charges were Tetryl (C.E.).

Fig. 2 shows diagrammatically the equipment finally used to produce satisfactory results. It comprises a mild steel die and pressure plate, a vacuum pump, and a thin sheet metal cylinder, about 16 in. high. In use, the cylinder is attached to the upper surface of the blank by waterproof adhesive tape, and a thin film of grease is applied to the upper surface of the die, to provide an air-tight joint, before the blank is placed on it. Next, the pressure plate is fitted, and the explosive charge suspended in the cylinder, which is then filled with water. Finally, air is evacuated from under the blank before the charge is detonated.



Twelfth-scale model of dome end of pressure vessel

In the course of the experiments, charges varying in weight from 30 grains to 80 drams were used, and they were located at from 2·5 in. to 8 in. above the centre of the blank. Also, the charges were made either cylindrical or hemispherical in shape. It appeared that the latter gave the most satisfactory results, although the evidence was by no means conclusive. It was found that, as with conventional press working, the pressure plate is essential to prevent wrinkling of the plate. Indifferent results were achieved with a vacuum of 24 in. Hg, the residual trapped air in the die causing dents in the dome ends. It was finally established that very satisfactory results could be obtained by using hemispherical charges of 400 grains, located 2·5 in. above the centre of the blank, a vacuum of 29 in. Hg, and 0·5 in. entry radius on the die. The dome ends so produced varied extremely little dimensionally, there being virtually no spring-back of the material, and the finish was very good. Further, there was relatively little change in the thickness of the finished material, the maximum reduction being about 0·003 in. This, presumably can be attributed to the explosive force being applied almost instantaneously over the whole surface of the blank, whereas in conventional press work there is a concentration of stress at the nose of the punch. Fig. 3 shows a formed dome when extracted from

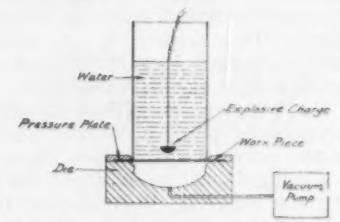


Fig. 2.—Diagrammatic arrangement of equipment used to produce domed end using an explosive charge

Figs. 3 and 4.—Domed end as extracted from the die and after trimming

the die, and Fig. 4 after being trimmed off.

Whilst explosive forming cannot compete with press working in large quantity production of components of normal materials, it can be economically attractive if small quantities are required, more particularly if the components are to be of good finish and dimensionally closely toleranced. Only a female die is required, and it is reported that good results have been obtained with wood, plastic and concrete dies, depending on the number of components required and the finish and dimensional requirements. Also, it has been stated that whilst some special alloys used in the production of components for guided missiles and very fast aircraft have proved unsatisfactory for cold working, they can be shaped by explosive forming. Components that have been partially pre-formed by welding parts together can be finished formed by explosive forming with damage to the weld. Practical considerations apart, there would appear to be no limit to the size of plate which could be worked; more precisely, the regular shaping of components from 0·3125 in. thick mild steel has been reported.

Although explosive forming is a relatively new technique, it would appear that it is sufficiently practicable to warrant the consideration of designers and production engineers.

Manufacture of Castellated Beams

Castellated beams have become a significant feature of many steelwork construction contracts. Frequently incorporated in the framework of buildings they also often remain exposed in finished structures to add to the architectural detail of the building. Though the appearance of castellated beams has undoubtedly assisted their popularization, their basic technical virtues have high practical appeal for the constructional engineer.

Fundamentally the system provides a means of increasing the strength of I-beams or other sections without increasing their weight. This is achieved by oxygen cutting the web of the beams to a predetermined and calculated profile as shown in the accompanying illustrations. The crests of the undulations are then welded together.

The net result is an increase in the depth of the beam by 50% which in effect means that the safe span of the beam can be increased in direct ratio to this increase in depth. An ideal application is that of long spans with light loading where stiffness is the predominant factor, as at the new factory of the Imperial Typewriter Company Limited a Hull.

Several beams can be cut simultaneously by using a Hancock longitudinal profiling machine. The method is automatic

This castellated beam cutting machine is completely portable and saves considerably in the handling of beams. The photograph shows the Hancock C.B.C. machine in action

The oxygen cutting of castellated beams is at present done by three different methods:

(1) By hand cutting, which has now virtually disappeared, largely for economic reasons.

(2) By stationary profiling machine.

(3) By portable specialized machine.

Cutting by stationary profiling machine is the most widely used technique for large scale production because it enables several beams to be cut simultaneously, as on the modern Hancomatic machine. A steel template is normally used in conjunction with magnetic drive, but aluminium strip templates are sometimes utilized: both methods of tracing are automatic. When cutting beams with a stationary profiling machine the worktable has to be effectively jigged to restrain the beams, as otherwise considerable movement might take place, due to release of rolling stresses.

Castellated beams are often required in small or medium batches and a demand arose for a portable machine which could be taken to the job. This has resulted in the Hancock castellated beam cutting machine, generally known as the C.B.C. This machine runs along the flanges of the beam and, as a result, distortion effects are practically eliminated in the finished profile.

The machine rides the flanges on two rollers one of which is driven. Ballbearing check rollers which engage the flange of the beam are mounted on adjustable brackets set to the required beam width on graduated stay bars. A clutch operated by a wing nut on the driving roller spindle enables the drive to be freed to facilitate setting and positioning on the beam.

The heart of the machine is the combined magnetic tracer and burner assembly which is roller mounted on stainless steel slide bars, and thus able to move transversely across the web of the beam to cut the sloping sides of the castellation profile. The templates are in the form of rotary cams.

Castellated beams are manufactured by the United Steel Structural Company Limited under the trade

name of 'Castella,' and by numerous licencees at home and abroad under British Patent 498281.

Safety Device for Winding Systems

A means of preventing the type of incident which can follow the accumulation of excessive slack in winding rope systems has been evolved by headquarters electrical engineers of the National Coal Board.

In winding systems where it is normal to support the cage at the upper level on keps of the type which can be withdrawn under load, the existence of excessive slack in the winding rope has often been the first circumstance contributing to a serious incident. When the weight of the cage is being supported on the keps, any movement of the winding engine tending to lower the cage will result in the formation of slack rope. Should the keps be withdrawn under this circumstance, the cage will fall freely to the extent of the slack rope.

For normal winding operations a completely tight rope system is impracticable but the necessary allowable slack need only be a small amount. The system put forward ensures that if slack rope beyond the acceptable minimum length has been formed, the lever whereby the keps are withdrawn will be rendered inoperative, and this circumstance will be made known to the winding engine operator by means of a visual or audible signal or both.

Normally, operation of the winding engine to raise the cage will take up the slack, and, when the cage is clear of the keps, automatically free the kep lever.

Should, however, winding be continued in the direction to form further slack rope, a tripping circuit will operate and the winding engine will be brought to rest.

With this system any movement of the winding drum after the cage has come to rest on the keps can be measured, the process of measurement being initiated by the detection of the cage weight on the keps. Safety measures come into operation automatically when the pre-determined lengths of slack rope have been formed.

A disc having a number of equally spaced holes near to its periphery is arranged to rotate with the winding engine, and the spacing between any two holes represents a known movement of rope. A photo-electric device is so positioned with respect to the disc that an electrical impulse is generated in its output circuit each time a hole in the disc passes the device.

A counting circuit is arranged to count the number of pulses and an acceptor circuit is arranged to allow the pulses to be counted only when the keps are supporting the weight of the cage. The loading on the keps is detected by means of strain gauges mounted one on each kep. The difference in electrical resistance between loaded and unloaded strain gauges is amplified and made to cause the operation of a relay and the circuitry is such that the device will work regardless of whether the keps are sharing the load equally or not.

The acceptor circuit, which is opened when the cage rests on the keps, also causes the counting circuit to reset to zero when the weight of the cage is removed from the keps.

The counting circuit initiates two separate actions. After a movement of the winding engine has resulted in the formation of a given length of slack rope a circuit is completed to a magnetic locking device arranged to prevent the withdrawal of the kep operating lever. Should the winding engine continue to move, thus forming a further pre-determined length of slack rope, a tripping circuit will interrupt the control circuit and the winding engine will be brought to rest. In the case of a winding engine not fitted with a circuit which can be interrupted, an emergency stop signal would be given to the winding engine operator.

Provided that a winding engine comes to rest before any appreciable length of slack rope has been formed, the proposed system will initiate no action. Hence if the keps are of the type which can be withdrawn under load, this may be done as soon as the cage is ready to be lowered.

A New Formula for Blanking and Piercing

The Production Engineering Research Association has carried out an extensive investigation to determine the relationship between blanking force and area of shear for a wide range of materials when blanking holes of 1 in. dia. Based on the large number of tests carried out, recommendations are given in a new report (the second to be issued on the subject) for accurate determination of the force required to blank circular holes of different sizes in a wide range of materials and thicknesses. A limited number of tests were also carried out using punches of 1 in. sq in order to determine whether the shape of hole had any influence on the blanking force.

It is found that variation in punch speed from 50 to 150 strokes per minute had no significant effect on the values of blanking force and stripping force.

Blanking force for spring steel, stainless steel, Nimonic-75, and electrical lamination steel is found to vary directly with the area in shear. Blanking force for mild steel, brass, aluminium alloy and copper does not vary directly with the area of shear and is apparently related to the stiffness of the blank (i.e., the ratio: blank diameter/thickness).

Blanking force is found not to eb dependent solely upon the ultimate tensile strength of a material and the area in shear. Shear factors, representing the ratio of the actual shearing strength and the ultimate tensile strength, have been derived for each material, and these may be used in accurate calculation of blanking force for circular components.

It was not possible to obtain any relationship between blanking force and shape of hole with the hole sizes investigated; a similar force per unit area in shear is required when blanking holes of 1 in. dia and 1 in. sq in brass.

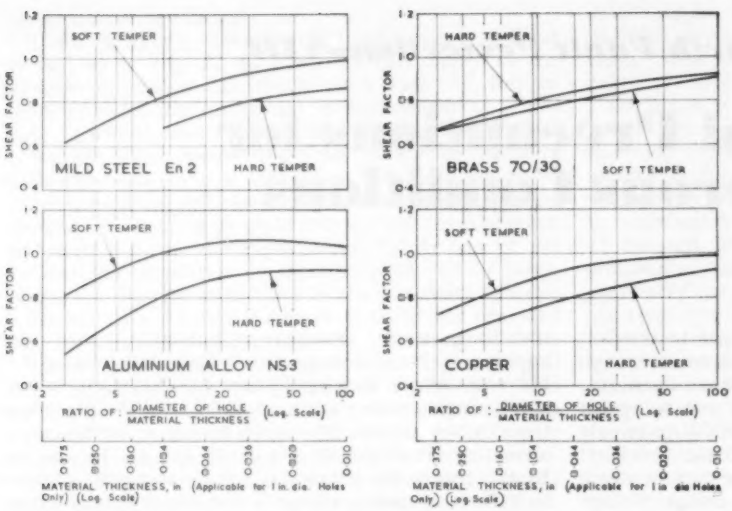
Statistical analysis of the results revealed that there was no significant difference in the blanking forces for each of the three punch speeds used in the tests. There was also no significant difference in blanking force when using clearances between the punch and die of 5% and 10% of the material thickness per side.

Average values of blanking force recorded for the various punch speeds and punch and die clearances were plotted against material thickness for each type of material, and compared with a calculated blanking force based on the following commonly used formula:

Blanking force =

Diameter of hole $\times \pi \times$ material thickness $\times$ ultimate tensile strength of material . . . (1)

The graphs show that the recorded blanking force is less than the value calculated from formula (1), and



Shear factor for blanking 1 in. dia holes in various metals

that in the case of mild steel, brass, aluminium alloy and copper, does not increase directly with the material thickness; blanking force for stainless steel, spring steel and Nimonic-75 alloy, whilst also less than the value calculated from formula (1), appears however, to increase directly with material thickness within the comparatively small range of thicknesses investigated, namely, 0·010 in. to 0·064 in.

In the graphs reproduced here the ratio:

$$\frac{\text{Recorded blanking force}}{\text{Blanking force calculated from formula (1)}}$$

referred to as the "shear factor" for the blanking of 1 in. dia holes in mild steel, brass, aluminium alloy and copper, is plotted against material thickness, and also against the ratio: Hole diameter/Material thickness. The shear factor actually indicates the relationship between the ultimate tensile strength and the actual shearing strength of a given material when punching circular holes. It follows, therefore, that an appropriate shear factor may be incorporated in formula (1) to obtain formula (2) as shown below, in order to determine accurate values of blanking force:

Blanking force =
Diameter of hole $\times \pi \times$ material thickness $\times$ ultimate tensile strength of material $\times$ shear factor . . . . . (2)

Since the blanking force for stainless steel, spring steel and Nimonic-75 alloy varied directly with material thickness, the shear factor for each of these materials will be a constant value for all thicknesses investigated. Taking the largest thickness, 0·064 in., in order to obtain the largest possible value and hence the greatest accuracy, shear factors were calculated for these materials from the ratio:

$$\frac{\text{Recorded blanking force}}{\text{Blanking force calculated from formula (1)}}$$

The range of thicknesses investigated with electrical lamination steel was too small to observe any thickness effects and therefore shear factors were calculated for each grade of this material for the thicknesses specified (see Table).

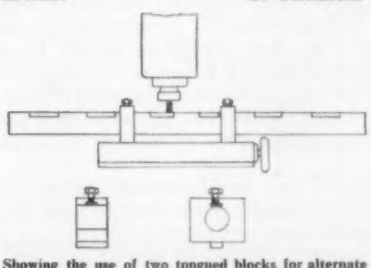
SHEAR FACTOR VALUES FOR SPRING STEEL, STAINLESS STEEL, NIMONIC "75" AND ELECTRICAL LAMINATION STEEL

Material	Material Thickness in.	U.T.S. ton/sq. in.	Blanking Force lb. for 1 in. dia. hole (a) Calculated from Formula (1)	(b) Recorded during Investigation	Shear Factor (b)/(a) %
Spring Steel (Soft) En 42A B.S. 1449 ..	0.064	43.4	19,500	16,700	85.6
Spring Steel (Hard) .. En 42A B.S. 1449 ..	0.064	57.6	25,950	19,000	73.2
Stainless Steel .. .. DTD 171B	0.064	44.7	20,126	16,300	81.2
Nimonic '75' Alloy .. DTD 703	0.064	51.0	22,962	14,800	64.4
Electrical Lamination Steel (0.35% Silicon)	0.020	18.0	2,533	3,190	126.1
Electrical Lamination Steel (2.33% Silicon)	0.014	29.0	2,856	3,400	119.2
Electrical Lamination Steel (3.48% Silicon)	0.014	35.7	3,515	4,130	117.5
Electrical Lamination Steel (3.99% Silicon)	0.015	36.4	3,842	4,420	115.1
Electrical Lamination Steel (4.28% Silicon)	0.012	37.2	3,141	3,600	114.6

Milling Keyways in Alignment

The standard vertical milling machine is invaluable in the small shop but the table is sometimes short in relation to the overall dimensions of the workpiece. Particularly is this the case with shafting in which a number of keyways have to be cut. The size of each keyway is well within the capacity of the machine but the table size and length of travel is inadequate for cutting all the keyways at one setting. The problem then is how to handle the shaft to ensure that all the keyways will be in line. The accompanying sketch shows a simple device which enables work of this kind to be done with speed and accuracy.

As shown in the sketch, two bored and tongued blocks are required, the bores being to suit the shaft, the tongues to suit the table slots, and as will also be seen there are set screws to secure the blocks to the shaft. For moving the shaft endways, one block is slackened and moved up to the other block and re-tightened. The second block is then slackened and the shaft, with first block attached, moved to a new position after which the second block is tightened. Repeated shifts can be made in this way, all the time keeping the keyways dead in line. **—G. Jackson.**



Showing the use of two tongued blocks for alternate location of a long shaft while setting up for repeated keyway cutting

Earth Leakage and Earth Fault Protection—VIII

Special Precautions for Dangerous Conditions

By J. L. WATTS

IN an earlier section reference was made to the fact that comparatively small leakage currents through the body may be dangerous under certain conditions; for instance in the event of the current not being cut off automatically and the person being unable to release himself from contact, or falling due to the shock. It was also pointed out that the value of the current which might pass through the body due to a certain voltage on exposed metalwork depends very largely on the contact resistance of the body.

It follows that special precautions may be necessary in certain cases where there may be a possibility of very good contact with exposed metalwork of the electrical apparatus and earth, or conducting materials in contact with earth. Such conditions may apply in connexion with damp processes, outdoors, or when using electrical equipment inside a boiler. Special risks may occur with portable (hand-held) apparatus, which may be plugged into various circuits without ascertaining whether the circuit is adequately protected, and where the earthing conductor in the flexible cable is liable to break due to frequent bending, etc.

In such places it may be possible to use "all-insulated" or "double-insulated" portable appliances, Where portable lamps are used at 30 to 250 volt the lampfitting should always be of the Home Office safety type, having a metal guard round the lampholder, the guard being separated from the lampholder by a considerable thickness of insulating material.

Reduce voltage for limitation of shock risk

Another safeguard is to supply the apparatus at reduced voltage. The B.S. Code of Practice 321 (1948) states "Where portable appliances having exposed metal parts, such as portable electric drills, are to be used industrially in situations other than earth-free situations, it is strongly recommended that such appliances should operate at a voltage not greater than 110 volt. Where such appliances are thus used, and an alternating-current system is in use, a double-wound transformer should be used, having a centre-tapped secondary winding with the centre tap solidly earthed. By this means the maximum voltage to earth is limited to half its operating voltage". For use in special places, such as boilers, 12 volt lamps are recommended.

Earthing for clearance of earth faults

It may be noted that the Electricity Regulations of the Factories Acts require earthing of the metallic casings of all portable apparatus working on a.c. of any voltage, or on d.c. above 150 volt, in a situation which is not "earth-free", i.e. in any place where there is a conducting floor or other conducting materials in contact with earth. However, if the voltage is sufficiently low to prevent danger it may be possible for the factory owner to claim exemption from these earthing requirements.

The I.E.E. Regulations permit the use of apparatus on voltages up to 30 volt a.c., or up to 50 volt d.c., without earthing of the exposed metalwork. This may avoid any risk of serious shock due to an earth fault on the appliance, but an earth fault on an appliance will only result in the current being cut off if the exposed metalwork of the appliance is connected to earth or to some point on the supply. If the appliance is not thus connected either directly or indirectly there may be a possibility of earth-fault current finding its way back to the earthed point of the supply through some unintended path which, under some circumstances, might involve risk of fire.

Fig. 1 shows a circuit in which a step-down transformer is used to supply more than one socket-outlet. It should be noted that, when used on a system having the mid-point earthed, the appliance should be controlled by means of a linked double-pole switch. Furthermore fuses or excess-current releases should be connected in each non-earthed pole of the supply to the appliance.

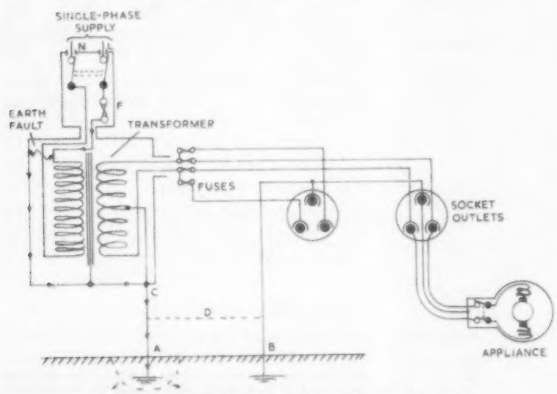


Fig. 1—Use of step-down transformer to supply portable appliances

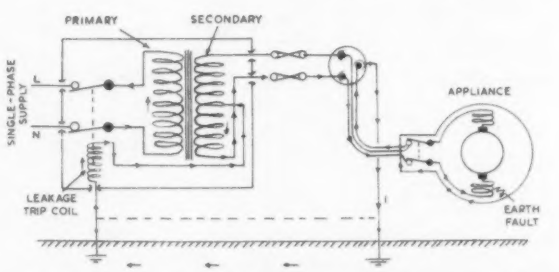


Fig. 2—Connexions of the Butcher-Black and Decker earth protection unit for single-phase portable appliances

Earthing must be efficient

If the secondary voltage is 110 volt, with mid-point earthed as in Fig. 1, no point on the supply to the portable appliance can reach more than 55 volt to earth provided the mid-point is maintained at (zero) earth potential, and the insulation of the transformer is sound. This means that the mid-point earthing electrode must have a fairly low resistance to earth. Otherwise earth-fault current from an appliance passing through the electrode A could create a volt drop between the neutral point and earth which raises one of the non-earthed conductors to more than 55 volt to earth. Where the exposed metalwork of the portable appliance is earthed to a different electrode B from that provided for the secondary mid-point, the resistance of both A and B must be low to provide a secondary earth-fault loop of sufficiently low impedance to ensure rapid melting of the secondary fuse, and to limit the volt drop between the casing of the appliance and earth in case of an earth fault on the appliance. If the exposed metalwork of the portable appliance is connected directly to the earthed mid-point, as by the conductor D in Fig. 1, earth-fault current from the appliance will not pass through the earth, and the possible voltage between the earth and the mid-point, or exposed metalwork of the appliance, will be unaffected by the resistance of either earth electrode.

However, an earth fault on the primary winding of the transformer will result in current passing to earth through the core-earthing electrode, as shown in Fig. 1. If this

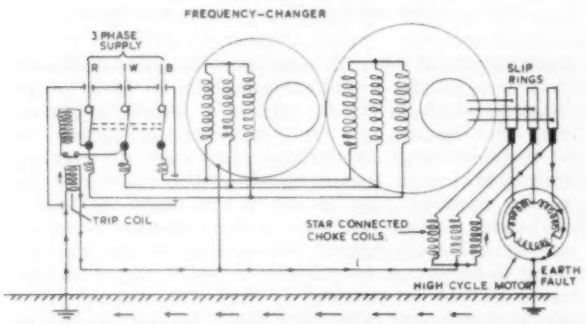


Fig. 3.—Butcher-Black and Decker system applied to high-frequency induction motors fed through induction frequency changer

electrode has a fairly high resistance to earth, or the primary earth-fault loop has a high impedance, or the primary fuses are large, the fault current may be insufficient to melt the primary fuse F. A volt drop at the core-earthing electrode will then cause the transformer core to be at a certain voltage to earth, which voltage will be transmitted to the mid-point of the secondary winding if this is earthed to the same electrode as in Fig. 1. This voltage will also exist between the metal casing of the portable appliance and earth, if this casing, the secondary-mid-point, and the transformer core are earthed through the same earth-electrode.

If this earthing electrode is the one provided for the main installation, i.e. if the exposed metalwork of the portable appliance, and the mid-point of the secondary winding are bonded to the exposed metalwork of the rest of the installation, voltage may exist between the casing of the portable appliance and earth should an earth fault occur on any part of the installation, which could render the reduction of supply voltage to the portable appliance quite ineffective. Similar conditions could occur in the event of a breakdown between the primary and secondary windings of the transformer.

Supply at reduced voltage from a secondary winding having earthed mid-point provides good protection provided certain conditions obtain. The primary and secondary fuses should be of the correct size. The transformer core should be well earthed; usually it will be satisfactory to bond this to the exposed metalwork of the rest of the installation. The mid-point of the secondary winding should be efficiently earthed, preferably to a separate electrode which is outside the resistance area of that provided for the transformer core etc. The primary and secondary windings of the transformer should preferably be mounted on separate limbs of an earthed core, or separated by an earthed metal screen. The impedance of the secondary earth-fault loop should be maintained at a low value, which is best achieved by connecting the exposed metalwork

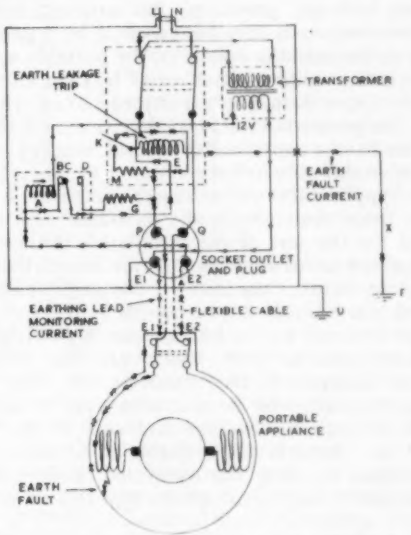


Fig. 4.—Connexions for a single-phase monitored earth-leakage circuit breaker

of the portable appliances to the earthed mid-point of the secondary winding. However, the latter connexion is inadvisable if there is a risk of break-down between the primary and secondary windings or the secondary mid-point is in any way connected to the exposed metalwork of the main installation.

Earth-leakage protection for portable appliances

The standard type of voltage-operated earth-leakage circuit-breaker may also be used for the protection of a portable appliance. It should be noted, however, that this cannot protect the operator against voltage reaching the metalwork of the portable appliance due to an earth fault on some other circuit having metalwork which is in any way bonded to, or in contact with, the portable appliance.

Fig. 2 shows the special Butcher-Black and Decker system of protection applied to a single-phase portable appliance which, if required, may be fed at mains voltage. The mid-point of the transformer secondary winding is connected to earth through a sensitive leakage trip coil.

Partridge Wilson & Co. Limited

Fig. 5.—A variable current earth-core tester

The voltage applied between either terminal of the portable appliance and earth is limited to half the secondary voltage, providing the earthing system is maintained intact, as may be indicated by a pilot lamp. So long as the earthing system of the portable appliance remains intact quite a small earth-leakage current on the appliance, will operate the trip coil to switch off the supply. The protection remains effective even if the earth electrodes have a resistance of several hundred ohms.

It is advisable to earth the exposed metalwork of the portable appliance(s) to an earth electrode which is separate from, and outside the resistance area of, that provided for the rest of the installation. Otherwise an earth fault on some other part of the installation might cause voltage between the casing of the portable appliance and earth which could not be cut off by the unit.

The system can be used to protect high-cycle (high-frequency) portable tools which are fed through a frequency changer. If the converter has four output slip rings the brushes on the neutral ring can be connected to earth through the leakage trip coil. If the neutral point of the output is not available an artificial neutral point, created by three star-connected choke coils, can be connected to earth through the trip coil as in Fig. 3.

Monitored earth-leakage protection

Positive protection is provided by the system shown in Fig. 4, which requires a four-core flexible cable for a single-phase appliance. The system is also available for the protection of three-phase appliances fed through five-core cables. It is necessary that the two earth-continuity conductors of the flexible cable be connected to two different points e_1 and e_2 on the metal casing of the appliance.

When the plug has been inserted into the socket-outlet the coil A of the relay can only be energized if the earthing cores of the flexible cable are intact and are connected to the appliance. In this case current from the 12 volt secondary winding of the transformer will circulate through the earthing cores and through the coil A, as indicated by the single arrows. The coil A will then close the contacts B-C to connect the metal casing of the appliance at e_2 to the earth electrode F through the leakage-trip coil E. If either of the leads to e_1 or e_2 should break or become disconnected the coil A will be de-energized, so that the contacts C-D will close to connect the live pole of the supply to F through the resistor G and the trip coil E, thus tripping the breaker.

Should an earth fault occur on the appliance the fault current will pass from e_2 to F via the contacts B-C and the trip coil E, as indicated by the double arrows, and the breaker will be tripped. The earth electrode F should be connected to the trip coil E by means of an insulated lead X, and should be outside the resistance area of any other direct earthing electrode on the installation. The case of the portable appliance is directly earthed from e_1 to E_1 and U, as may be required by regulations. It is advisable that the earth electrode U be separate from, and outside the resistance area of, any other earth electrode on the installation. If the metal casing of the unit, and the casing of the portable appliance through e_1—E_1, are bonded to other exposed metalwork on the installation, an earth fault on some other item might result in voltage between the casing of the portable appliance and earth. Whilst this might cause the coil E to trip the breaker this action would afford no protection since the leakage current would not be passing through this breaker.

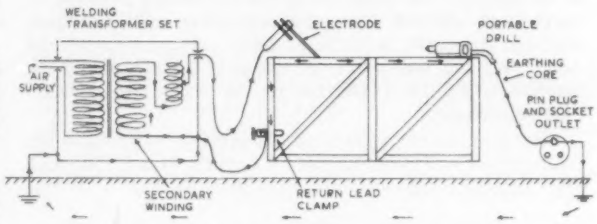


Fig. 6.—Possible path of secondary current of an arc welding set

Earthing core of a flexible cable should be tested frequently

In view of the considerable amount of fairly rough usage to which the flexible cable of a portable appliance may be subjected, and the possible consequences if an earth fault occurs on the appliance when the earthing lead is broken, it is most desirable that the continuity of the earthing core of the flexible cable be tested periodically when not used with earth-monitoring or earth-proving equipment. The strands of the core are liable to break one by one over a period, and a severed earth wire is not revealed in normal use except by a shock in the event of an earth fault. An earth fault may fuse the few remaining strands of a partially broken earthing core.

Fig. 5 shows a test set which is suitable for flexible cables rated up to 20 amp. The earthing core of the flexible cable to a portable appliance is tested by simply plugging the appliance into the appropriate socket-outlet on the test set, placing the casing of the appliance in contact with the metal bridge and pressing the push button, after setting the current selector switch. A current of about five times the current rating of the cable is then passed through the earthing core, as indicated by the ammeter; which gives a zero reading if the earthing core is broken, disconnected or wrongly connected. If only a few strands of the core remain intact these will be fused by the test current.

Earthing of arc welding equipment

On many a.c. arc welding sets in use one end of the transformer secondary winding is connected to the earthed case or tank of the transformer, as in Fig. 6, to which point the return lead is taken from the welding table or work. Sometimes the clamp used at the work

end is in a poor condition and may then constitute a high resistance connexion in the return lead, or the return lead may become broken in time or the clamp come adrift.

Should such faults occur a comparatively high voltage, up to the secondary voltage of the transformer, might then exist between earth and the welding table or work. This could result in electric shock, or in fire if current returns to the earthed point through some conducting path which is not intended to carry such current. Fig. 6 shows a possible effect of a high resistance at the work-table clamp. It will be seen that an appreciable current may then pass through the earthing core of the flexible cable to a portable drill in contact with the table which might be sufficient to ignite the cable.

A better arrangement is to use a welding transformer having both poles of the secondary winding insulated, the tank of the transformer being earthed in the usual way. Three flexible leads are then taken from the welding set as follows, (a) the lead from one secondary terminal to the welding electrode via the regulator, (b) the return lead from the work to the other secondary terminal and (c) an earthing conductor of adequate size from the transformer tank to the welding table or work. Provided the insulation of the secondary winding and return lead is maintained in good condition, no current can then pass to earth in the event of breakage or high resistance of the return conductor.

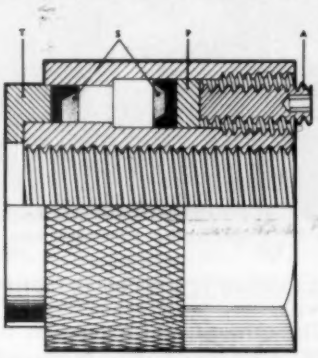
The Euco hydraulic nut obtains greater pressure with less effort

Hydraulic Nut

Under normal circumstances, a nut can only be tightened on its mating stud or bolt with a pressure dependent on the applied force which is proportional to the length of the spanner used and the weight of the man behind the spanner, plus very frequently, the slight additional effects of heavy hammer blows on the spanner in order to obtain the last ounce of pressure.

In order to find the maximum amount to which a 1 in. B.S.F. nut could be tightened with the above normal methods, a test rig incorporating a load cell and pressure gauge was set up by the makers and the nut tightened with a spanner 16 in. long by a man weighing 11 stone 4 lb. They report that the pressure recorded, including the few ounces contributed by several heavy hammer blows, was 2 ton per sq in. This is considerably less than should theoretically be obtained but most of the applied force is absorbed by friction on the threads and face of the nut, involving an area of approximately 4½ sq in. in frictional contact.

The "Euco" hydraulic nut was developed with a view to obtaining greater pressure with considerably less effort and at the same time to eliminate the torsional strains which are inevitably present when tightening a nut in the conventional manner. Employing the same test



Body of nut showing annular recess

rig, a 1 in. B.S.F. hydraulic nut was screwed on hand tight, this initial pressure registered ¼ ton per sq in. The hydraulic pressure was then applied, by turning the $\frac{5}{16}$ in. pressure screw with an Allen key, as shown in the illustration, the pressure then registered 4 ton per sq in. This increase in pressure was, therefore, obtained with an applied force from finger and thumb. Removal of the nut was just as effortless, the pressure screw was unscrewed to release the pressure and the nut removed by hand.

A further test was made by screwing the nut on with a spanner to provide an initial pressure of 1 ton per sq in., the hydraulic pressure was then applied as before and the pressure rose to 5 ton per sq in.

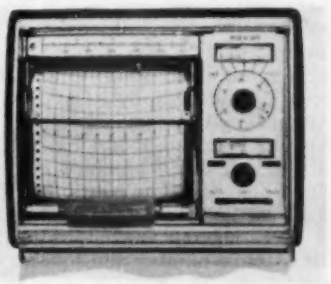
The body of the hydraulic nut is made from high tensile steel and an annular recess is formed in the front face. The recess communicates with a bore passing through to the rear face, the bore is threaded to receive a reducing bush which accommodates the pressure screw A. The recess and bore are filled with a special compound and enclosed with seals at S. A thrust ring T fits in the recess bearing against the front seal whilst a pressure pad P bears against the rear seal and transmits the pressure applied by the screw A.

The hydraulic nut has already been applied to problems of which the following are typical:

(1) The two halves of a main bearing for a large Diesel engine required clamping together for a precision boring operation. The size of the two clamping bolts was 12 in. long by 2½ in. dia and the nuts required to be tightened with considerably more than normal pressure. This was previously obtained with a special low geared mechanical nut runner which was expensive, cumbersome and laborious to operate. The work is now undertaken with two hydraulic nuts with little effort, less time and at a fraction of the previous cost.

(2) A gang of four circular cutters were clamped together on an unkeyed spindle for a machining operation. Insufficient clamping pressure resulted in the cutters frequently slipping under the cutting load. This trouble was eliminated by the replacement of the ordinary nut with the hydraulic nut.

Hydraulic nuts are now being produced by Euco Tools Limited, 44 London Road, Kingston, Surrey, in all sizes from ¾ in. to 2 in. dia and are available with Whitworth, American, unified and metric threads.



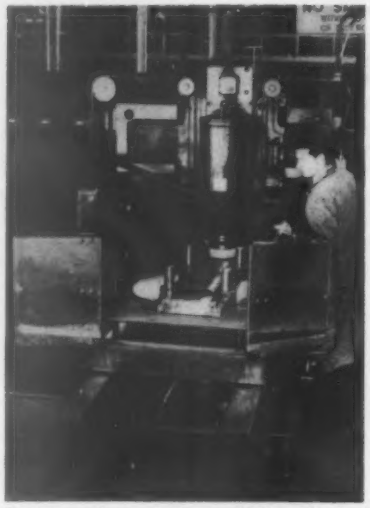
E.C.I. INSTRUMENTS.—The new series of electronic Consotrol instruments introduced by Foxboro Yoxall Limited, Redhill, Surrey, includes measurement transmitters, recorders (shown here) and controllers for flow, pressure, temperature, etc., using transistorized and magnetic amplifier designs to provide, for the first time, 100% solid state electronic construction. There are two controller types: the universal controller, transistorized, with fully adjustable controller settings (P.B., integral and derivative), and flow controller, magnetic amplifier, with controller settings fixed at optimum values

Precision Grinding Tool Joint Faces

A long-felt need in industries associated with the production and use of dies and tools, is equipment for the rapid precision machining of flat joint faces and particularly those fitted with locating dowels, to permit complete grinding at one setting. The Lumsden Machine Company Limited, Gateshead, for whom Alfred Herbert Limited, Coventry, act as world-wide agents, have made an extensive research into this need and have added to their range of surface grinders an entirely new machine known as the No. 230X.

This plano-type machine not only meets the requirements of the toolroom and maintenance shops where the grinding and modifications of die-sets and tools are produced, but also enables a wide range of relatively large and complex surfaces to be precision ground. A high order of accuracy in finish, size and parallelism is obtained.

The machine is of the vertical spindle type. The rotary table is mounted on a carriage which is reciprocated under the wheel by means of a hydraulic cylinder, giving infinitely variable speeds from 5 to 30 ft per min. The reversal of the table is smooth and free from shock, which enables fine finishes to be obtained, whilst fine hand movement to the wheelhead, vertically and transversely, permits grinding close to a shoulder or a die pin or locating dowels.



Precision surface grinding a die base fitted with locating dowels, on a Lumsden No. 230X surface grinding machine

The carriage, which supports the table and its driving worm and motor, slides on double V-ways, which are fully protected throughout their length. The table, which rotates on an oil bath track, can be either 30 in. or 48 in. dia and has individual motor drive giving two speeds of 8 or 16 rpm.

The machine base, which is a heavy box section casting, houses the hydraulic pump and motor, the reverse and control valves and the oil tank.

Hand-operated Embosser

A hand machine which embosses letters and numbers on hard-wearing, corrosive- and chemical-resisting vinyl red plastic tape which has a pressure sensitive adhesive backing for instant and easy application to most smooth and clean surfaces, has been introduced by The British Automatic Company Limited, 14 Appold Street, London EC2. It is 10½ in. long and is precision made in chrome plating. The plastic labelling is self-feeding and all that is required in operating the machine is to dial the letter or number and squeeze the handle.

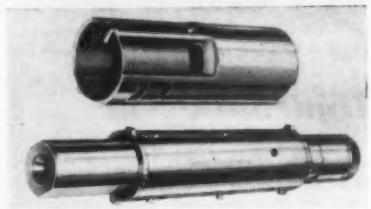
The machine has obvious uses for labelling raw materials, containers for chemicals and tools, identification for wiring and electrical parts, labelling instruments, tanks, motors, stock shelves, etc.

This machine embosses letters and numbers on hard wearing, corrosive and chemical resisting vinyl red plastic tape which has a pressure sensitive adhesive backing for instant and easy application to most smooth and clean surfaces

The plastic labels are embossed with permanently raised letters 5/32 in. type size. The tape is ½ in. wide by 12 ft long. The price of the machine is £12. 10s.

Hydraulic Mandrel

The latest addition to the range of units made by Larrad Hydrajaws Limited, 44 Leigh Street, Coventry, is the Hydramandrel, a patented self adjusting hydraulic mandrel. The illustration shows a typical example with the work piece for which it was designed; it is used for grinding outside diameter and end faces with a high degree of concentricity and freedom from distortion. The knurled actuating nut is at the extreme end of the Hydramandrel, and by merely turning this nut through 90° is sufficient to grip the work piece firmly for machining.



Typical example of a Hydramandrel with the work piece for which it was designed

Loading and unloading is quick and floor-to-floor time for the illustrated work piece is only a few seconds.

The Hydramandrel illustrated has a range of ¾ in. dia whilst a 6 in. dia mandrel will grip any bore size between 6 in. and 8 in. dia. It will also grip any irregular shaped, stepped or tapered bore within that range. The Hydramandrel can also be used for turning or milling and can be operated by air cylinder if desired.

Wire and Strip Forming

The latest and largest addition to the Heenan range of automatic wire and strip forming machines—the S3 Multiform—is being shown by Heenan & Froude Limited, Worcester, at the 1960 Machine Tool Exhibition. Specifically designed for the economical and high-speed production of heavier and more complex strip components, the S3 is capable of manufacturing components to a blank length of 12 in., a maximum width of 3 in., and up to $\frac{3}{32}$ in. thick at speeds ranging from 40 to 120 pieces per minute.

The die area extends to a maximum length of 31 in. and facilities for piercing or raising from the front or rear of the strip are incorporated. All four camshafts are inter-geared, and a fly-wheel, incorporated in the drive system to ensure smooth running, may be manually or automatically divorced from the machine, by which means the considerable inertia built up in the fly-wheel does not have to be dissipated by the rotating parts before the machine can be brought to rest. Thus the machine may be stopped immediately—automatically if required. The controls may be linked electrically to ensure that the machine is automatically brought to rest under certain conditions such as short feeding, buckling of strip, running out of stock and the like.

The connecting linkages to the reciprocating feed are in a substantially straight line from the operating crank disc, thus giving a straight through-pull from the crank to the feed and ensuring accuracy. The stock is gripped between a pair of flat dies, one of which is mechanically operated by a cam. To ensure that strip up to 3 in. wide by $\frac{3}{32}$ in thick is securely held, the grip is positively applied and released by a self-contained locking mechanism which avoids sustained side thrust on the feed slide.

Sufficient room has been provided on the bed-plate for two press units as well as the standard front cut-off. The horizontal press is designed with a standard die space of 10 in. and the entire press assembly can be adjusted along the bedplate to obtain the best working position. A load of up to thirty tons can be obtained on each press, allowing a substantial amount of die work to be carried out.

Each of the four slides is individually operated by a separate hardened and ground steel cam, each capable of exerting a force of 6 tons through the slide to the component.

The new Flexibox lapping machine Mark 15A for lapping the surfaces of components to optical standards of flatness

Low-cost Lapping Machine

Expressly designed as a small low-cost machine for lapping the surfaces of components to high standards of flatness and surface finish, the new Flexibox Mark 15A lapping machine combines large capacity with compact and neat appearance. Maximum overall dimensions of only 32 in. × 22 in. × 20 in. enable the machine to be bench mounted. In addition, anti-vibration pads eliminate the need for bolting down.

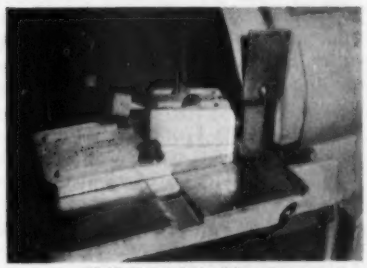
The machine will deal with a wide variety of articles made from almost any constructional material—plastics, light alloys, ceramics, ferrous metals, etc. A 15 in. dia lapping plate equipped with three wear rings provides large capacity. For example, 66 components of 1 in. dia can be lapped at one and the same time. Larger components up to a maximum diameter of 5½ in. can be handled.

An automatic flatness control device maintains the lapping plate truly flat at all times so that the machine can be operated by unskilled personnel. The machine is also fitted with a timing device which can be pre-set for any desired interval—for normal use the range is 0–60 min—at the end of which the drive motor is automatically shut off. Coloured warning lights give a visual indication of whether the machine is in operation or not so that constant supervision is unnecessary.

The makers are Flexibox Limited, Nash Road, Trafford Park, Manchester 17.

Diamond Dresser

An adjustable diamond wheel dresser for off-hand grinders has been introduced by Keith Precision Engineering, 276 Upper Shoreham Road, Shoreham-by-Sea, Sussex. The dresser, for which British and foreign patents are pending, is for wheels up to ¾ in. wide and work rests up to 2 in. wide. With an adaptor plate it has an extended range of 4¾ in., giving a total adjustment of 4 in. The diamond carrier has a movement of ½ in.



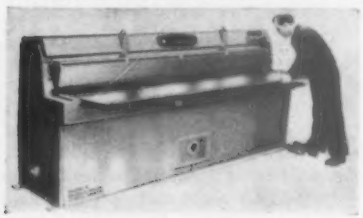
Keith diamond wheel dresser

The tool provides a true cylindrical diameter or side face on all wheels. It has incorporated in the design a presenting and trailing angle to give best dressing and a self-sharpening action. The presenting angle is in the body and the trailing angle is made by lining up either angle on the front of the body with the edge of the work rest.

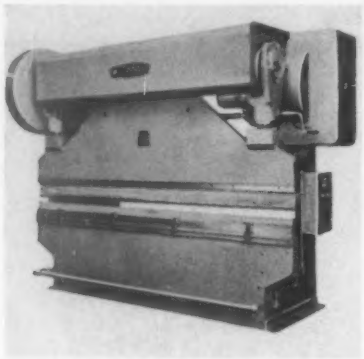
Cutting Oil

Formula-C made by the Plus-Gas Company Limited, of 1–11 Hay Hill, London W1, is a harmless, non-acid and non-corrosive fluid, whose main constituent is a high grade oil of exceptionally low surface tension. This allows it to penetrate intergranular crevices in the surfaces of metals being machined and also to establish a permanent film of fluid between tool and workpiece throughout the operation.

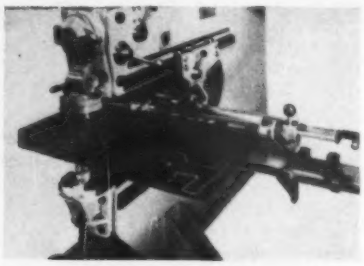
A clean cutting action is thus assured, while "build-up" on the edge of the cutting tool is greatly reduced. In addition a film of oil remains on the finished workpiece, protecting it from metallic corrosion after the operation is completed.



Besco-Truecut guillotine



Besco-Truebend press brake



Trumpf copy nibbler

New Besco Machines

F. J. Edwards Limited, 359-361 Euston Road, London, N.W.1, introduce several new machines at the International Machine Tool Exhibition on Stand No. 8 in the Grand Hall. They are the Besco-Truecut guillotine, Besco-Truebend press brake, Besco TRB plate bending roller, Besco automatic folding machine and the Besco horizontal section roller.

The Besco-Truecut guillotine, Model 8/125, 8 ft × $\frac{1}{8}$ in. and model 8/25, 8 ft × $\frac{1}{4}$ in., is of all-steel construction and of the undercrank type. It has an electrically operated friction clutch and has a magnetic brake. Automatic hold-down and precision back gauge are provided.

The Besco-Truebend press brake, Model 60/120, is also of all-steel construction. It has a capacity of 60 ton and will form mild steel, between side frames, 8 ft × $\frac{1}{8}$ in. with a die opening of $1\frac{1}{8}$ in.; and over the full die length, 10 ft. × 12 S.W.G. with a die opening of $\frac{7}{8}$ in. The machine is motor-driven with a treadle operated disc-type clutch.

The Besco plate bending roller, Model TRP 8/25, has a capacity of 8 ft × $\frac{1}{4}$ in. in mild steel. It is motor driven through worm gear reduction box. A companion model TRH 24 has a capacity of 4 ft × $\frac{1}{8}$ in.

The Besco all-steel horizontal section rolling machine will deal with angles, leg out, of $2\frac{1}{2}$ in. × $2\frac{1}{2}$ in. × $\frac{3}{8}$ in. to a smallest diameter of 24 in.; and, leg in, of 2 in. × 2 in. × $1\frac{1}{4}$ in. to a smallest diameter of 18 in., and with channels, tees, flats on edge and on flat, rounds and squares, in proportion. The machine is motor driven.

The Besco production box and pan press brake, Model 48/15, has a capacity of 15 ton and will form mild steel up to 48 in. wide by 12 S.W.G. over a $1\frac{1}{4}$ in. V-die. It is an undercrank motor driven machine with a swing out beam for forming and removing complete trunk sections or alternatively a deep beam comprising a number of removable fingers for the forming of deep trays in one piece of metal.

The Besco production all-steel box and pan folding machine, Model BP 414, has detachable fingers for forming 4-sided trays up to $8\frac{3}{4}$ in. deep from one piece of metal. The capacity is 48 in. wide by 14 S.W.G. in mild steel.

The Besco production all-steel treadle guillotine has built-in sheet hold-down. Its capacity is 48 in. wide by 16 S.W.G. in mild steel.

The Besco production universal all-steel motorized swaging, wiring and jennying machine, Model E14, has standard rollers for use on discs and cylinders. The depth of gap is $14\frac{1}{2}$ in. and the capacity 14 S.W.G. in mild steel.

The Besco motorized automatic folding machine is of steel plate construction and has a capacity of 98 in. × $\frac{1}{8}$ in. in mild steel. The movement of the folding and clamping beams is from a worm reduction gearbox, with limit switches controlling the amount of movement. Push-button control is provided. The weight of the machine is about 11,000 lb.

The Besco all-steel universal double-ended punching, shearing, section cropping and notching motor-driven machine, Model KBL 13, shears plates of any length or width up to $\frac{1}{2}$ in., punches 1 in. dia through $\frac{7}{16}$ in. plate, notches up to $\frac{3}{8}$ in. thick steel and crops angles and tees at 45° and 90°. It deals with channels, rounds and squares in proportion.

The Trumpf universal shearing, nibbling and flanging machine, Model TAS 42/1050, will trim and cut sheets straight through. It cuts curved shapes internally or externally and will nibble, bead, pein, fold, cut louvres etc. The capacity in shearing is 16 in. mild steel; the Model TAS 80 has a maximum capacity up to 0·32 in. The throat depth is 49 in.

A unique machine is the Trumpf universal copy-nibbler, Model CN 63-1500. It can be used for copy or co-ordinate nibbling from templates and also for the operations given above for the Model TAS 42/1050. Depth of gap is 59 in. and capacity in nibbling 0·16 in. mild steel. Both these machines are made by Trumpf, Germany.

A Mitre cold circular saw by Hans Kaltenbach, Germany, has a saw blade $13\frac{3}{4}$ in. dia and will give a depth of cut of $3\frac{3}{4}$ in. and length of cut 12 in. The machine will deal with solid bars up to $2\frac{1}{2}$ in. and other sections in proportion.

Another Kaltenbach machine is a hydraulic circular cold saw with a saw blade 30 in. dia and capacity for rounds and tubes up to 9 in., other sections in proportion.

Magnetic Work-holding Devices

As originators and patentees of the flux-controlled permanent magnet chuck James Neill and Company (Sheffield) Limited have advanced their plans so that a wide range is available to meet even the latest production problems. At this year's Machine Tool Exhibition they show an interesting extension to the 'Eclipse' range of chucks in the addition of three entirely new sizes which are primarily designed for super-precision grinding on the larger surface grinders. These chucks have working surfaces of 20 in. × 10 in. (AX.2010), 24 in. × 10 in. (AX.2410) and 24 in. × 12 in. (AX.2412).

They are not heavy duty chucks but have been designed to make the

best use of modern materials with a closer pole spacing than existing large sizes, provision having been made for these to be modified from standard independent types to multiple units which can be mounted end to end thus providing a continuous magnetic surface. The top plates of all these wider chucks have a central support which entirely eliminates any tendency towards deflexion of the work-holding surface under load making them eminently suited to the most accurate grinding operations.

The new 'Eclipse' permanent-electro magnetic chuck operates on a new principle, the permanent magnet poles being energized *in situ* whilst in actual contact with the workpiece, and the electrical current being applied only for magnetizing and demagnetizing so that any failure or mechanical interruption of the power supply cannot affect the holding of the work on the chuck face.

Automatic Co-ordinate Setting

A patent electronic universal surfacing, boring, milling, drilling, tapping and screwcutting machine fitted with the A.E.I. two-dimensional automatic co-ordinate setting system is being exhibited by H. W. Kearns & Co. Limited, Broadheath, Manchester, on Stand 56 in the Grand Hall at the International Machine Tool Exhibition. This machine has been specially designed and developed to take advantage of the accuracy available from this new system of electronic control. It is of the universal type, extremely powerful and arranged to operate on workpieces of five to six tons. The 4 in. dia spindle is combined with a built-in facing chuck capable of machining up to 42 in. dia and fitted with the latest patented feed mechanism to the facing slide. By employing the Kearns unit principle, the feed and drive boxes have been combined to work in complete harmony with the electronic control.

The main table is 4 ft × 9 ft and is fully supported by carrying it on a saddle supported in turn on a main bed having a total width of 8 ft 9 in. The outer ends of the saddle are carried on four large diameter rollers mounted on anti-friction bearings. This design ensures long life and accuracy to the longitudinal guides which is essential if an accurate transverse movement of the table is to be obtained throughout the full length.

The patented system provides two full ranges of mechanical feed in inches per minute and inches per revolution of the spindle to the longitudinal movement of the tables, axial travel of the main spindle and radial movement of the facing slide.

A special patented multi-jack revolving table 5 ft sq is fitted on the main table, and even when carrying an off-set load it can be rotated easily.

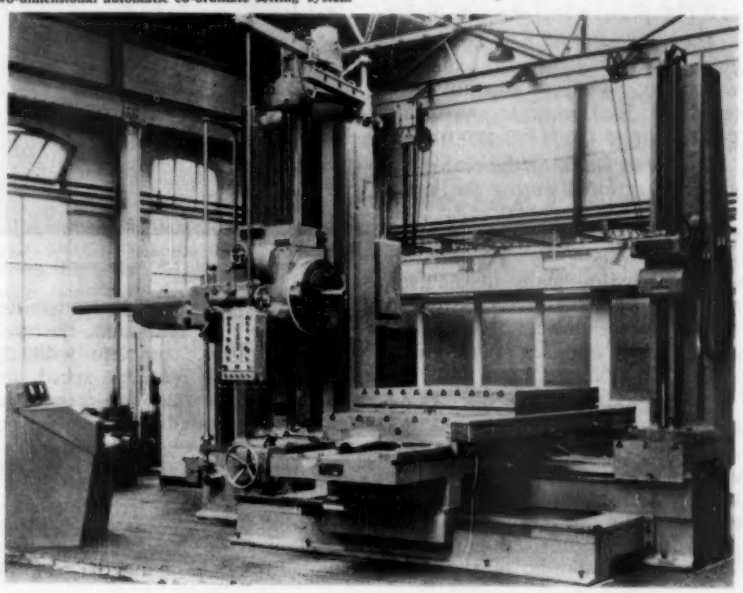
To avoid slip-stick movement on the slides a patented arrangement has been devised for the transverse movement of the main table. This consists of a number of resiliently mounted rollers which, combined with the special lubrication system, enables a smooth movement to be achieved even under heavy load.

The machine is provided with cushioned drive between the eight-speed gear box mounted on the main bed and the spindle slide. This slide contains four gear changes which, combined with those in the main drive box, give a total of thirty-two speeds to the machine.

The 4 in. spindle is fitted with hydraulic tool clamping and release. The spindle is bored No. 50 non-stick taper and the tool mandrels are held in position by a central draw-bar operated by a powerful spring. The draw-bar and the mandrel are connected by a simple bayonet type fitting. Hydraulic pressure is applied to remove or reject tools from the spindle and this is controlled by a switch mounted on the spindle slide. Automatic hydraulic clamping is fitted to the vertical adjustment of the spindle slide and boring stay bearing and to the longitudinal and transverse movements of the main table.

The A.E.I. automatic co-ordinate setting system comprises servo mechanisms operating the vertical traverse of the spindle slide and transverse movement of the main table. Movements can be made to any position according to the co-ordinates which are indicated on dials seen on the face of the control desk. Six dials with clearly displayed figures are provided for each of the two ordinates and can be set to any required displacement in tens of inches, inches and four decimal places from any predetermined datum. The dials can be set individually by hand or in groups by means of a standard punched card. A pack of these cards can be carried in the automatic card reading unit. They can be arranged in sequence and when placed in the feed hopper, are individually read before being ejected into the collecting hopper.

An inspection window is provided to enable the operator to read the top card. The reading unit can be operated either from the control desk or from the pendant. Displacement figures can be viewed through windows adjacent to each dial.

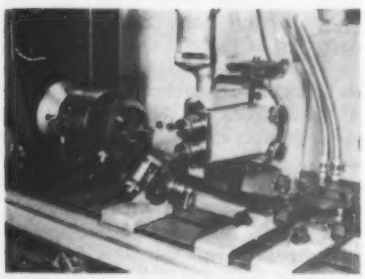


No. 3 W.B. Kearns patent electronic universal surfacing, boring, milling, drilling, tapping and screwcutting machine fitted with the A.E.I. two-dimensional automatic co-ordinate setting system

Spline Shaft Grinding

Fritz Werner AG, West Berlin, for whom the sole selling agents in the United Kingdom are Rockwell Machine Tool Company Limited, Welsh Harp, Edgware Road, London NW2, have recently introduced an internal grinding attachment for their 3·275 range of precision automatic spline shaft grinding machines. This attachment enables the flanks of spline bores to be ground providing the number of splines is even. Grinding spindles are available to cover bores from $\frac{13}{16}$ in. to $3\frac{3}{8}$ in. dia.

To fit the attachment, the normal grinding spindle and wheel dressing unit are removed and the attachment is mounted in the bore of the headstock. The grinding wheel is belt driven from a motor mounted vertically above the main housing.



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The cams for controlling the hydraulically operated cross movement of the internal grinding spindle are mounted on the machine table as is the special wheel dressing device.

The workpiece is held in a 3-jaw chuck mounted on the standard workhead. A fine adjustment is provided for accurate horizontal positioning of the spline grooves.

The lower flank of the rear spline groove is ground during the left to right travel of the hydraulic table. On reaching the reversing point the grinding spindle is automatically traversed hydraulically to the front so that during the reverse stroke of the table the lower flank of the diametrically opposed spline groove is ground.

On completion of the double stroke, i.e., when the table has reached its extreme left-hand position and the grinding wheel is clear of the work, the dividing head indexes automatically and brings the next groove into the horizontal position. The grinding spindle is also automatically traversed to its rear position and the grinding process repeated.

By following this procedure, one grinding pass is carried out on all flanks as the workpiece is rotated through 360°, and after resetting the grinding spindle in the vertical position the next grinding pass is undertaken on all flanks. This operating cycle is repeated until the finished dimensions of the spline grooves are reached.

Tool Room Borer

Developed from the already well-known range of Kearns S type machines, the new S type Optimetric horizontal tool-room boring machine is intended for dealing with components of approximately 1 ft cube which require holes to a high degree of finish and accuracy both between centres and in the bore. The vertical column is of the central thrust type with two square sectioned guides at the front and a similar arrangement at the back. This four point support to the headstock ensures great rigidity and stability.

The spindle is mounted on precision ball and roller bearings. Drive to the main spindle is through a system of V-belts and pulleys with an infinitely variable speed range from 50 to 2000 rpm.

Kearns optimetric horizontal tool-room boring machine, high-speed, "S" type spindle model

In order to reduce the transmitted vibrations to a minimum, the main driving motor, complete with the Kopp infinitely variable speed unit and the associated two-speed gear box, are mounted on an independent base plate alongside the machine. The main driving motor is a 2 hp unit.

A built-in draw bolt and extraction mechanism is fitted to the main spindle for holding standard No. 40 non-stick taper mandrels in the spindle nose.

The compound table, which is fitted with an 18 in. square revolving table, is provided with an infinitely variable power feed unit. This comprises a $\frac{1}{4}$ hp constant speed motor driving a Kopp unit which gives feeds from $\frac{3}{16}$ in. to 4 in. per min available to either the longitudinal or transverse motions. This stepless feed unit gives the ability to use the machine for fine boring operations by combining a low feed rate with a high spindle speed. At the same time, the high feed rate in the transverse direction is invaluable in allowing light milling operations to be carried out at the most efficient rate.

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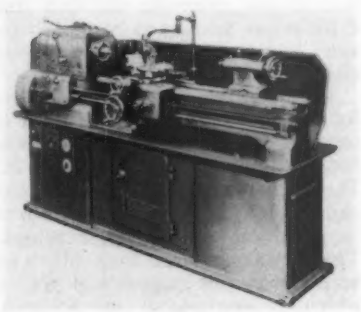

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The accelerator will have an energy rating of 4·3 million electron volts and will give an X-ray output of over 600 röntgens a minute in air at 1 metre focus film distance. Because of its high energy rating it will make possible faster radiographs through greater thicknesses of material than is practicable with conventional X-ray or isotope sources. With an exposure time of less than 100 sec, using Ilford industrial F-film, the accelerator will produce a high definition radiograph of a steel specimen 6 in. thick; with faster film the exposure time for this thickness would be reduced to under 60 sec.

The accelerator is specially designed for use on site during the building of a nuclear power station with a minimum of disturbance to the constructional work. It is compact, easily controllable and has comprehensive positioning facilities for easy and accurate location on the specimen.

The accelerator unit will be mounted in a trunnion fork assembly and will weigh approximately 1·3 ton and measure about 8 ft overall length. Its power supply and control units will be housed in a transportable cabin which may be placed up to 250 ft away from the accelerator unit. Besides giving greater flexibility for on-site operation, this will enable the operators to keep well clear of radiation from the machine.

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With a source diameter of approximately 2 mm the resulting X-ray photographs show a sensitivity better than 0·5% on steel specimens between 4 and 8 in. thick and 0·8% with thicknesses of about 2 in. These results are obtained using standard D.I.N. wire penetrameters, the film (Ilford industrial F) being exposed to give a density of 2·5.

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The flux scanning head is designed to be interchangeable with the control rod mechanisms and uses the same standpipe closure and seal plug. At Trawsfynydd, a two wire system will be used so that the wires can be used alternatively. This is necessary since it takes about one week for the activity of the irradiated wire to decay to less than 1% when it can be used again. By the two wire system the period of waiting is reduced to three or four days.

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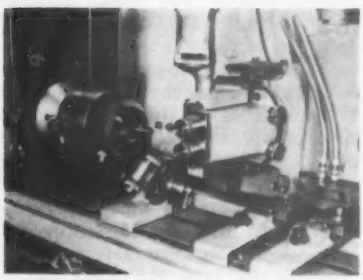

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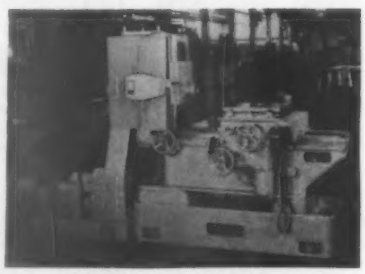

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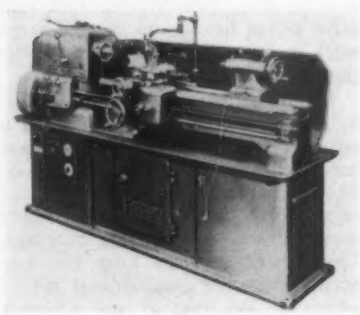

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Car Maintenance and Repair. By Arthur W. Judge. London, 1960; Chapman and Hall Limited. 25/- net (by post 26/2). 464 pp. 5 × 7½ in.

The number of books on this subject is legion and the ordinary car-owner for whom the majority are written must be perplexed by the row of similar titles on the bookshop shelf. One advantage enjoyed by the present work is that it has stood the test of time; it was first published in 1928 and now appears in the fifth revised edition. This contains a considerable amount of new material and new illustrations.

The book is particularly meant for the owner-driver and in an introductory chapter the author outlines the work which can be satisfactorily undertaken by the amateur and gives suggestions for furnishing a small garage. The remaining chapters deal with various items of maintenance and repair from lubrication to cleaning upholstery and there are useful final chapters on storage and on diagnosing engine troubles easily. Nearly 350 illustrations complement a text which is both thorough and reliable.

Diesel-electric Locomotive Tests.—Bulletin No. 14 newly issued by the British Transport Commission (price 10/-; Room 268, 222 Marylebone Road, London NW1) presents performance and efficiency tests carried out on the Brush Traction type 2 1250 bhp diesel-electric locomotive. The engine is a Mirrlees V-type 12 cylinder turbo-charged four-stroke fitted with a Woodward governor. The Brush electrical equipment includes a main self-ventilated generator and four axle-hung traction motors. Control is by varying the excitation of the main generator and the speed of the diesel engine. The locomotive was extensively fitted with instruments for the tests, the results of which are presented in tabular and graphical form in the bulletin. More recent locomotives of this type are uprated to 1365 hp and are capable of a maximum service speed of 90 mph.

Atomic Energy Reports in Microfilm. Unclassified reports from the Atomic Energy Research Establishment, the Atomic Weapons Research Establishment, and the Industrial Group of the United Kingdom Atomic Energy Authority, published between 1946 and December, 1956, are now available in microcard form from Micro Methods Limited, by permission of the United Kingdom Atomic Energy Authority. Many titles are also available on microfilm. A catalogue may be obtained from Micro Methods Limited, Bradford Road, East Ardsley, Wakefield, Yorks.

The Engineer Buyers' Guide.—In addition to a classified directory to sources of machinery and plant, "The Engineer Buyers' Guide" contains lists of forthcoming exhibitions, engineering associations and institutions, national undertakings, trade names, etc. The guide is price 9/3 (post free) from "The Engineer", 28 Essex Street, Strand, London WC2.

books

"Work Study".—A publication of this title by R. M. Currie, (Head of I.C.I. Central Work Study Department and president of the Work Study Society), from The British Institute of Management, puts together experience and knowledge of work gained more particularly since 1947. The author has revised the material contained in the three BIM booklets in the "Outline of Work Study" series and has expanded it by the addition of extra chapters. "Work Study" is published for BIM by Pitmans at 22s. 6d. (plus 1/3 for postage).

Calculul Proceselor de Ardere.—We have received a book of this title, in Rumanian, from Institutule de Energetica, Bucarest. It is by G. Baranescu and is concerned with explaining the methods of calculation of practical thermodynamics—that is in relation to fuel burning plant. The theoretical notions are first thoroughly explained and then the author goes on to a generalized treatment and finally to a number of examples. The book of 392 pages is accompanied by a wallet containing a considerable number of graphs and diagrams.

Kempe's Engineers Year-book.—The 1960 edition of Kempe's contains new sections on electronic engineering, nuclear power, prestressed concrete, diesel locomotives and railcars, railway brakes, railway signalling, and naval architecture, as well as numerous additions in other sections. The price of the two volumes in case is 87/6 (postage 2/6 extra). The publishers are Morgan Brothers (Publishers) Limited, 22 Essex Street, Strand WC2.

For the convenience of readers—

Books mentioned on these pages may be ordered by post through MECHANICAL WORLD Offices. Please state, author, title, publisher and price by post when ordering.

Mechanical World Offices: 31 King Street West, Manchester 3.
158 Temple Chambers, Temple Avenue, London, E.C.4

Erratum

"The Key to Accounting and Costing" is the correct title of the book reviewed in our May issue under the title "The Key to Cost Accounting". Costing forms only a small portion of the book.

New Standard

Heat sensitive detectors for automatic fire alarm systems in buildings (B.S.3116:1959). Price 4/-.

The "point" or "spot" detectors dealt with in this new British Standard are small but vital components of automatic fire alarm systems used in buildings. They are fixed to ceilings: and their role, when affected by hot gases from the fire, is to set off the alarm. This new publication specifies type tests for ensuring that the detectors will operate satisfactorily. One test stems from the fact that the time of response of a heat sensitive detector to fire conditions depends on the rate of growth of the fire, the efficiency of heat transfer to its sensitive element, the adjustment or "setting" of the detector and its indicating equipment, and the placing of the detector in the building. The test measures the response time of a detector under conditions representative of the range of air temperatures and velocities occurring beneath the ceiling of an enclosure in which a fire is developing. The limits set for the detector to pass the test have regard to the location and purpose of the alarm system, according to the type of building protected. Other tests deal with resistance to the effects of vibration and of corrosive influences after installation. Resistance to the effects of marine atmospheres is assessed by means of a "salt droplet" test. Here, the equipment is suspended in water, from which it is removed once daily to be sprayed with a salt solution. This treatment is continued for sixteen days, after which the efficiency of the detector is required to be unimpaired. A Foreword explains the purpose of the tests, and the specification contains full particulars (including diagrams and a photograph) of the apparatus required.

British Standards Institution, 2 Park Street, London W1.

BUSINESS & PROFESSIONAL

Personal

THE ROYAL SOCIETY has announced the awards of grants by the Paul Instrument Fund Committee. One is that of £3000 to **Mr. H. W. Gosling**, lecturer in the department of engineering, University College of Swansea, for the construction of an instrument for checking the stability of the standard ampere.

THE BRITISH BROADCASTING CORPORATION announced the following appointments to take effect from July 1, 1960 **Sir James Fitzjames Duff** to be vice-chairman of the Corporation until June 30, 1962; **Mrs. Rachel Marianne Jones** to be National Governor for Wales until June 30, 1962; **Mrs. Thelma Cazalet-Keir, C.B.E.**, to be re-appointed Governor until June 30, 1961.

DOWTY GROUP LIMITED announces the following appointments. **Mr. F. Bastow** has been appointed managing director of Dowty Seals Limited. **Mr. C. F. Porter** and **Mr. K. G. Ware** have been appointed to the board of Dowty Mining Equipment Limited. **Mr. C. N. King** has been appointed to the board of Dowty Hydraulic Units Limited.

Mr. W. Lionel Fraser, C.M.G., has been appointed the first president of Babcock & Wilcox Limited. **Sir Kenneth Hague** becomes the chairman of the board and **Sir Reginald Verdon Smith** the deputy chairman.

Mr. H. Crowther, formerly managing director, has been appointed chairman of Baker Perkins (Exports) Limited. **Mr. H. S. Hargreaves**, formerly deputy managing director, has been appointed managing director. **Mr. A. I. Baker**, chairman of Baker Perkins Limited, the parent company and formerly chairman of the export organization will continue as a director. Mr. Crowther is also vice chairman of the board of management of Baker Perkins Limited.

Mr. A. M. Champion, M.B.E., has been appointed manager of Perkins Engines Limited's vehicle engine sales branch. **Mr. L. G. T. Roberts, M.Inst.B.E., Assoc.I.E.E.**, has been appointed assistant manager of Perkins Engines Limited's industrial engine sales branch.

Mr. H. R. Brunyee at present works manager (services) at the Steel, Peech and Tozer branch of The United Steel Companies, is to retire on July 31, 1960, and will be succeeded by **Mr. M. Thomas**, at present assistant works manager (services).

BRUSH ELECTRICAL ENGINEERING COMPANY Limited announce the following appointments: **Mr. H. C. R. Trewman, A.M.I.Mar.E., A.M.I.E.E.**, has been appointed marine sales specialist from May 1, 1960. **Mr. R. L. Oddie, F.C.A.** secretary, has been appointed a director, and **Mr. F. H. Wood, A.M.I.Mech.E., M.I.Loco.E.**, manager of the Traction division, is appointed executive director.

Mr. A. J. Filer, C.B., general manager of the Directorate General of Works, Ministry of Works, will retire on August 14, 1960. Thereafter the Directorate General will consist of **Mr. C. G. Mant, C.B.E., F.R.I.B.A.**, who will be appointed director general, **Mr. E. Bedford, C.B., C.V.O., A.R.I.B.A.**, chief architect, and **Mr. A. B. Mann, C.B.E., B.Sc.(Eng.), M.I.C.E., M.I.Mech.E.**, chief engineer.

Mr. Richard Fairey has on medical advice, retired from the board of directors of the Fairey Company Limited and has relinquished his position as vice-chairman.

BRITISH AIRCRAFT CORPORATION LIMITED has been formed by Vickers Limited, The English Electric Company Limited and The Bristol Aeroplane Company Limited to bring together their respective aircraft and guided weapon interests. The first director of the new company will be: **Marshal of the Royal Air Force Viscount Portal of Hungerford, K.G., G.C.B., O.M., D.S.O., M.C.** (chairman); **Major-General Sir Charles A. L. Dunphie, C.B., C.B.E., D.S.O.**, (deputy chairman); **The Hon. George Nelson, M.Inst.C.E., M.I.Mech.E., M.I.E.E.** (deputy chairman); **Sir Reginald Verdon Smith, LL.D., B.C.L.**; **The Rt. Hon. Viscount Caldecote, D.S.C., A.M.I.Mech.E., A.M.I.E.E., A.F.R.Ae.S.** (executive director, Guided Weapons); **Sir George R. Edwards, C.B.E., Hon.F.R.Ae.S., Hon.F.I.A.S.** (executive director, Aircraft); **Mr. William Masterton, C.A.** (financial director); **Mr. G. A. Riddell, C.A.**; **Mr. R. P. H. Yapp.** The secretary of the company will be **Mr. J. O. Charlton, F.C.I.S.**

Mr. W. J. Heywood, chairman and managing director of S. H. Heywood & Co. Limited, has taken over the direction of the Reddish Crane Works (owing to the death of his cousin Mr. S. W. Heywood) in addition to the Manchester electrical contracting works. Mr. Heywood has been a director of the company since 1934. The directors have appointed **Mr. W. Howe** and **Mr. A. L. Hawes**, both of whom have been employed with the company for sixty years, to be general managers of the Manchester and Reddish works respectively.

BRAY CONSTRUCTION EQUIPMENT COMPANY Limited, Feltham, Middlesex, has appointed **Mr. Maurice S. Hall** to the position of assistant home sales manager. Mr. Hall, who joined the company in 1957 as a senior area representative, was previously with Dowty Hydraulic Units, where he was in charge of contracts and sales.

BRITISH INSULATED CALLENDER'S CABLES Limited announce that **Mr. J. Conning, A.M.I.E.E.**, formerly production manager power cables division, has been appointed works manager, Erith Works, responsible to the general manager, power cables division.

BICC—Burndy Limited recently appointed two sales engineers—**Mr. J. G. Fisher** and **Mr. A. S. Ferguson**—who will be based at Prescot.

BRITISH INSULATED CALLENDER'S Construction Company Limited announces the retirement of **Mr. G. A. Rendle, B.Sc., M.I.E.E.**, who has been deputy general manager since August, 1958.

HUMPHREYS & GLASGOW LIMITED of London, fuel and chemical engineers, announce the election to the board of **Mr. R. Langford** and **Mr. I. H. Phillipps.**

W. G. PYE & COMPANY LIMITED announce that **Mr. Neil Fenwick** has been appointed sales promotion manager.

KEITH BLACKMAN LIMITED announce that **Mr. C. J. Atkins** (sales director) and **Mr. F. W. Goodge** (contracts director) have been appointed joint assistant managing directors. Consequent upon the above the following new appointments became effective from June 1: **Mr. F. W. Brown**, commercial manager; **Mr. E. A. Manning**, V. Dept. manager; **Mr. R. F. Williamson**, contracts manager and **Mr. P. C. Burden**, chief draughtsman (contracts).

Mr. George Ellison, Jnr., has been elected to the boards of directors of the associated companies, George Ellison Limited, Alfred Ellison Limited and Tufnol Limited. Mr. Ellison is the grandson of the late Mr. George Ellison., the founder of all three companies. **Mr. T. J. Rowlands, B.Sc., A.M.I.E.E.**, has been appointed chief engineer and manager of the engineering department of George Ellison Limited.

THE appointment of **Mr. L. H. Pomeroy** as director marketing, United Kingdom Operations, is announced by Massey-Ferguson (United Kingdom) Limited, Mr. Pomeroy's appointment follows the resignation of **Mr. T. V. Knox** from that position. **Mr. Arthur Whiteley**, assistant managing director, Massey-Ferguson (Export) Limited, retired June 10 on reaching his 60th birthday, and on medical advice. He will be available in a consultative capacity.

COCHRAN & CO., ANNAN LIMITED, of Annan, Dumfriesshire, announce the appointment of **Mr. A. D. C. Gunn,**

B.Sc.(Eng)., M.Sc., F.Inst.F., as technical director.

SHORT BROTHERS & HARLAND LIMITED announce the appointment of **Mr. E. G. Collinson, B.Sc., A.F.R.Ae.S.,** as chief mechanical engineer to the company's aircraft division.

THE following have been appointed executive directors of Tecalemit Limited: **Mr. T. R. Hardman** (sales); **Mr. H. E. Jackson, B.Eng.** (engineering); **Mr. J. E. Drinkwater** (production).

Mr. Arthur Sykes, O.B.E., B.Sc., Wh.Ex., M.I.Mech.E., M.I.P.E., M.S.A.E. was recently presented with a gold medal by British Gear Manufacturers Association in recognition of his outstanding services to the British gear manufacturing industry. Mr. Sykes, who is 72, is technical consultant to the David Brown Gear Group, with headquarters at Huddersfield.

WOLF ELECTRIC TOOLS LIMITED, London, have just appointed **Mr. Klaas van Walraven** as sales supervisor for Holland.

Obituary

WE regret to record the death of **Mr. W. M. Grainger,** director and secretary of Walter Somers Limited of Hales Owen. Mr. Grainger was also a director of the subsidiary company, Walter Somers (Materials Handling) Limited.

WE regret to record the death of **Mr. C. H. Frankland, M.I.E.E.,** director of British Insulated Callender's Construction Company Limited.

Addresses

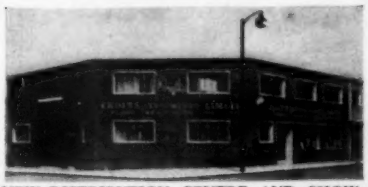
ROYCE ELECTRIC FURNACES LIMITED are now at their new premises at Albert Drive, Sheerwater, Woking, Surrey. Telephone Woking 5401-4.

THE telephone number of the Liverpool branch of British Insulated Callender's Cables Limited has been altered to Maritime 2424. The telephone number of the BICC Dundee branch has also been altered and is now Dundee 25726/7.

THE Nottingham office of Cambridge Instrument Company Limited now operates from larger premises at Century Insurance Building, Milton Street, Nottingham. Telephone: 42612.

DYMET ALLOYS LIMITED are now at their new address, Frimley Road, Camberley. (Telephone 4433/4). Dymet is an associate company of Rockweld Limited, arc welding equipment manufacturers, who will also move to Camberley later this year.

EXPANDITE (CANADA) LIMITED, has now been established as a manufacturing and trading company and the new company will market the products of the Expandite Group throughout Canada. The company's address is: 96, Vine Avenue, Toronto 9, Ontario, Canada.



NEW DISTRIBUTION CENTRE AND SHOWROOMS.—The new specially designed Birmingham branch office for Crofts (Engineers) Limited, power transmission specialists, at 253–255 Great Lister Street, under the managership of Mr. A. L. Duckering

A new division of R. J. Richardson & Sons Limited, of Commercial Street, Birmingham 1, to be known as Site Shot-blasting (Gt. Britain), has recently been formed to take care of the shot blasting on site of work too large to be catered for by transport into the company's works. A competent staff under the personal supervision of a site manager is available.

THE INDUSTRIAL FAN & HEATER COMPANY Limited, one of the members of the Simms group of companies, have moved their London headquarters from Barnet to Remax House, Alfred Place, London WC1. Telephone Langham 9561, where all enquiries in connexion with Airflo fans, ventilators and dust collecting products will be dealt with in future.

REED MEDWAY SACKS LIMITED is the new name of Medway Paper Sacks Limited. The address remains the same—Larkfield, near Maidstone, Kent.

INTERNATIONAL RECTIFIER COMPANY (Great Britain) Limited, are now in their new factory at Oxted, Surrey, where they will produce selenium rectifiers and silicon diodes. The company is a joint venture by Metal Industries Limited and the International Rectifier Corporation of Los Angeles.

A NEW United States company named The Perkins Engine Company Incorporated has been formed with headquarters in Detroit. It will market the products of the British diesel engine company of F. Perkins Limited, of Peterborough, Northants.

ATLAS COPCO AB, compressed air engineers, is now building a new plant in India located about 120 miles east of Bombay at Poona, where a number of other Swedish enterprises have built or are building factories. It will be known as Atlas Copco India (Private) Limited.

A NEW sales company jointly owned by Dunlop Rubber Australia Limited and Oldham & Son Limited, Manchester, is to be set up in Artarmon, Sydney, N.S.W., Australia, under the title of Dunlop Oldham Pty. Limited. The new company will market the Oldham PG double sleeve tubular traction and other industrial batteries throughout Australia.

A NEW company, Parsons Powergas, with headquarters in London, has been formed as a joint enterprise by The Ralph M. Parsons Company, Engineers Constructors of Los Angeles and P. G. Engineering Limited, a member of The Power-Gas Group, an organization of British companies founded in 1901.

Contracts and Work in Progress

DAVID BROWN MACHINE TOOL DIVISION.—Order worth £80,000 for the supply of machine tools and ancillary equipment for Czechoslovakia, placed by Stroj/Import, Prague.

HEENAN & FROUDE LIMITED.—Froude FA 5 hydraulic dynamometer for the Research Centre of Ruston & Hornsby Limited, Lincoln.

Froude hydraulic dynamometer for use in experimental work with gas turbines for the Japanese Defence Agency, Tokyo.

FERRANTI LIMITED.—Orion data processing system for the Prudential Assurance Company Limited. Installation of the system and conversion of existing records will take from two to three years.

Order from National Institute for Research in Nuclear Science for an Orion electronic digital computer for installation at the Institute's Rutherford High Energy Laboratory at Harwell, Berks. Value £¼m.

Pegasus digital computer for the College of Aeronautics at Cranfield.

WILLIAM BAIN & CO. LIMITED. Coatbridge. —Fabricated structural steelwork valued at about £110,000 for the Bridgetown Hospital, Barbados.

ASSOCIATED ELECTRICAL INDUSTRIES Limited.—*Heavy Plant Division:* Two 40-MVA synchronous condensers for Central Electricity Generating Board's sub-station at Iver, Bucks. *Turbine-Generator Division:* first contract placed by the Comision Federal de Electricidad, Mexico, for AEI power Station, value nearly £3¼m. to be built at Ciudad Juarez. *Switchgear Division:* contracts for air-blast circuit breakers at the step-up sub-station at the Mazatapec hydro-electric plant; and for air-blast circuit breakers for the New Zealand Maraetai I and II power stations on North Island.

WILLIAM BOBY & CO. LIMITED, Rickmansworth.—Contract valued at £2500 for base exchange plant for the new boiler house of the South Durham Iron & Steel Company's North Works.

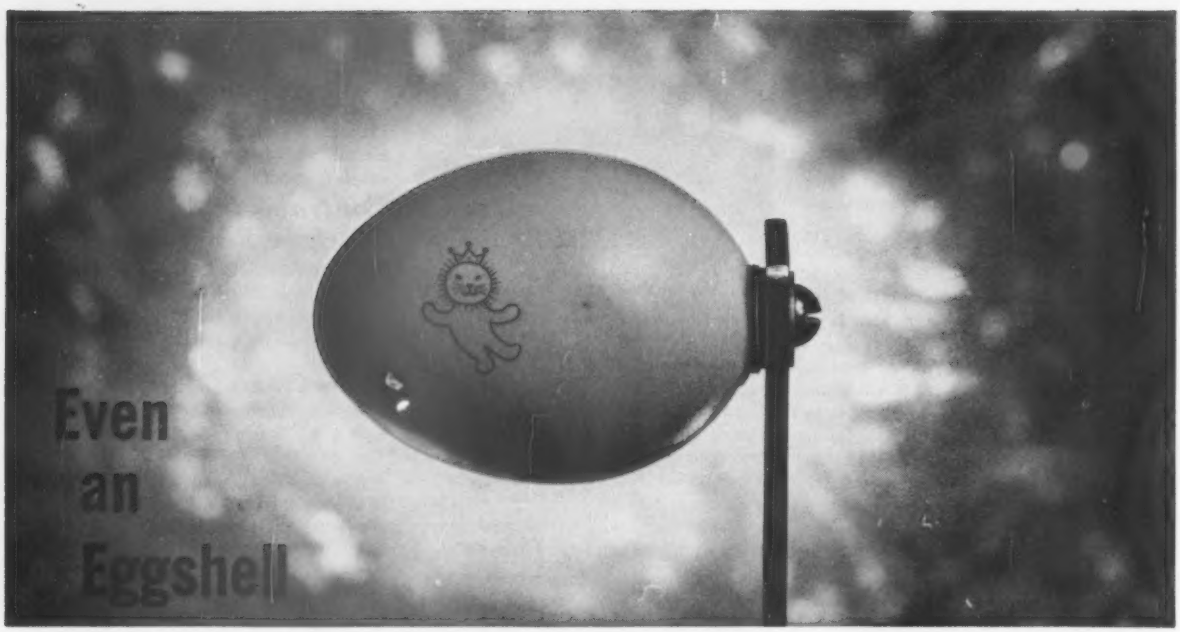
Contract valued £3500 for demineralization plant for U.K.A.E.A. at Harwell.

Contract valued at £800 for a second demineralization unit for Fisons Limited research laboratory near Ipswich.

Contract worth £2170 for small deaerator for the Metropolitan Water Board.

Lime-soda plant for the N.C.B. Linby colliery valued at £3595.

Pilot demineralization plant, valued at several thousand pounds, for Courtaulds Limited for export to U.S.S.R.



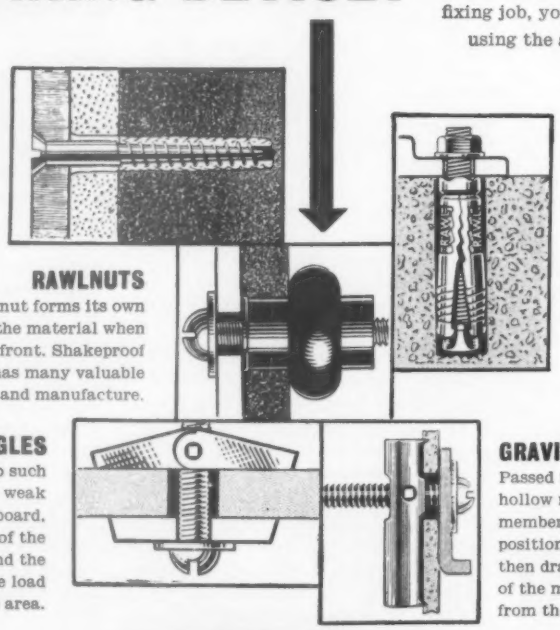
can be Screw-fixed with a RAWLPLUG FIXING DEVICE!

If you live to a hundred, you are unlikely to want to do much screw-fixing of eggshells! Yet this feat—possible only with a Rawlplug Fixing Device (a Rawlnut)—does serve to highlight the astonishing effectiveness of these Devices in making 'difficult' and even 'impossible' fixings simple and straightforward. Whatever the screw or bolt fixing job, you'll save time, money and temper by using the appropriate Rawlplug Fixing Device.

RAWLPLUGS
The famous Rawlplug makes firm screw fixings in masonry in a mere fraction of the time taken by any other method. For all screw sizes up to ½" diam. coach screws.

RAWLNUTS
The amazing Rawlnut forms its own 'rivet head' behind the material when screwed up from the front. Shakeproof and waterproof, it has many valuable uses in both building and manufacture.

SPRING TOGGLES
For making firm fixings to such thin and structurally weak materials as plasterboard, ceilings, etc. The wings of the device spring apart behind the material and spread the load over a wide area.



RAWLBOLTS
For light or heavy bolting jobs. A dry fixing of enormous strength—no cold chiselling, no waiting for cement to harden. In all bolt diameters up to 1".

GRAVITY TOGGLES
Passed through a hole in hollow material, the long member falls into a vertical position by gravity, and is then drawn against the back of the material by screwing from the front.

IMPOSSIBLE FIXINGS ARE EASY WITH RAWLPLUG **FIXING DEVICES** *For Speed and Strength!*

The World's largest manufacturers of fixing devices

THE RAWLPLUG COMPANY LTD., CROMWELL RD., LONDON S.W.7

B469

DEWHURST & PARTNER LIMITED, Hounslow.—Supply of individual motor starter and lighting control panels for the Spencer works of Richard Thomas and Baldwins Limited at Newport, Mon.

WILD-BARFIELD ELECTRIC FURNACES Limited, Watford.—NRC Vacuum induction furnace for the Permanent Magnet Association.

PERKINS ENGINES LIMITED, Peterborough.—£35,000 order for four cylinder diesel engines for use in U.S. designed German built Clarklift fork lift trucks placed by Ruhr Intrans Hubstapler G.M.B.H. of Mulheim.

PARKINSON COWAN (Measurement Limited Division).—Order from the Capetown Municipality, South Africa, for over 20,000 type '44' water meters, through their agents, Fraser and Chalmers (SA) (Pty) Limited.

E.M.I. ELECTRONICS LIMITED.—Emidec 1100 all-transistor computer for the Admiralty, value over £1¼m.

BROOKHIRST IGRANIC (M.I. Group).—Crane controls valued at £120,000 for the new Spencer works of Richard Thomas & Baldwins at Llanwern, near Newport, Mon.

HONEYWELL CONTROLS LIMITED.—Initial orders for over 250 Electronik strip chart recorders from W. G. Pye Limited and Unicam Instrument Company Limited.

CRYPTO LIMITED (M.I. Group).—Contracts for £4000 worth of potato chippers for the Royal Air Force.

GENERAL ELECTRIC COMPANY LIMITED.—Order approaching £100,000 in value from Jessop-Saville Limited for the supply of an induction melting furnace of 1 ton capacity. (In association with Vacuum Industrial Applications Limited and the British Geco Engineering Company).

Order from the British Steel Castings Research Association for a vacuum melting and casting furnace for their experimental foundry.

BRAY CONSTRUCTION EQUIPMENT LIMITED.—Fourteen additional tractor shovels, to the total value of £48,000, for export to Sweden.

TAYLOR & HUBBARD LIMITED, Leicester.—Order from British Railways (Scottish Region) for two 10-ton diesel-electric rail travelling cranes.

WAKEFIELD-DICK INDUSTRIAL OILS LIMITED.—Nominated suppliers of lubricants to C.E.G.B. nuclear power station to be erected at Dungeness.

FIRTH CLEVELAND STEEL STRIP LIMITED, Tipton.—Supply of specified tonnages of Fircleve brand hardened and tempered steel strip for German Democratic Republic.

FILM COOLING TOWERS (1925) LIMITED.—Contract value about £600,000 for three 4,800,000 gal/hr natural draught cooling towers for C.E.G.B. Thorpe Marsh power station.

Business Developments

Trading agreements

GLENFIELD & KENNEDY LIMITED have recently concluded a licensing agreement with Schmitz & Schulte, Germany, whereby they will supply S. & S. diaphragm valves to U.K. and Commonwealth markets from their Kilmarnock works.

GENERAL agreement has been reached between A.E.I. Limited and A. Reyrolle & Co. Limited, and C. A. Parsons & Co. Limited for a joint programme of research.

U.K. ATOMIC ENERGY AUTHORITY have signed collaboration and licensing agreements with W. J. Fraser & Co. Limited and with Nuclear Chemical Plant Limited.

Company acquisitions

CHEMETRON CORPORATION of Chicago have acquired from Shaw-Petrie Limited the Glasgow firm of Clyde Tube Forgings Limited.

IMPERIAL CHEMICAL INDUSTRIES LIMITED, in collaboration with the Aluminium Company of America (ALCOA), have acquired the Almin Group of Companies with total assets of about £5m.

TELEFLEX LIMITED of Basildon, Essex, have acquired Conveyor Construction and Engineering Company Limited.

TAYLOR WOODHEAD SPRINGS LIMITED have acquired the light coil spring section of John Spencer & Sons (1928) Limited of Newburn-on-Tyne. The business will be continued under the name John Spencers (Light Springs) Limited.

DOWDING & MILLS LIMITED, Bordesley, have acquired the business of Southern Electrical Repairs Limited, Southampton.

Agents and distributors

THE TESA DIVISION of Matchless Machines Limited have appointed Listers Wholesale (B'ham) Limited, 143 High Street, Smethwick, area distributors for Warwickshire, Staffordshire and Shropshire.

Film News

THE G. B. FILM LIBRARY, 1 Aintree Road, Perivale, Greenford, Middlesex, have issued a pamphlet giving synopses of their films for training salesmen and full particulars of hire rates and purchase prices. Two new titles have been added to the list, *Presenting Your Sales Case Convincingly* and *More than Words*.

Films on Materials Handling.—The list of Films on Materials Handling has now been revised and augmented to include particulars of approximately 100 films. Copies, price 2/- post free, may be obtained from the Secretary, National Joint Committee on Materials Handling, 32 Watling Street, London, EC4.

CJB Scholarships

CONSTRUCTORS JOHN BROWN LIMITED have entered into an agreement with The Institution of Chemical Engineers for the award of two scholarships, the purpose of which is to encourage research in chemical engineering and, in particular, in chemical plant design.

Approved Tests

NASH & THOMPSON LIMITED, Hook Rise, Tolworth, Surbiton, Surrey, announce that they have now been given approval as a Part III Test House by the Director General of Inspection for functional and performance testing of electronic components including testing under environmental conditions.

Trade Literature

Electroplating

The last few years has seen a rapid growth of the Ionic Plating Company Limited, of Grove Street, Birmingham 18. The companies facilities are described in a new folder and include barrel plating, vat plating, and making heavy deposits in nickel, copper and chromium for engineering customers.

Special Forgings

The GKN Bolt & Nut Division has a special section for the production of forgings to close tolerances. Electrical upsetting is done on stock up to 12 in. long, extrusion up to 4 in. head dia, and any special forgings can be made up to those requiring not more than 700 tons to forge. A new catalogue illustrating typical work done by the department is available from Guest Keen & Nettlefolds (Midlands) Limited, Atlas Works, Darlaston, South Staffs.

Self-locking Nuts and Screws

The Wedglok principle is applied to both nuts and screws. It embodies a tough, resilient nylon pellet inserted into a cavity in the screw thread and this wedges securely in the mating thread. Full particulars are given in a folder available from Guest Keens & Nettlefolds (Midlands) Limited, Box 24, Heath Street, Birmingham 18.

Refractories for Land Boilers

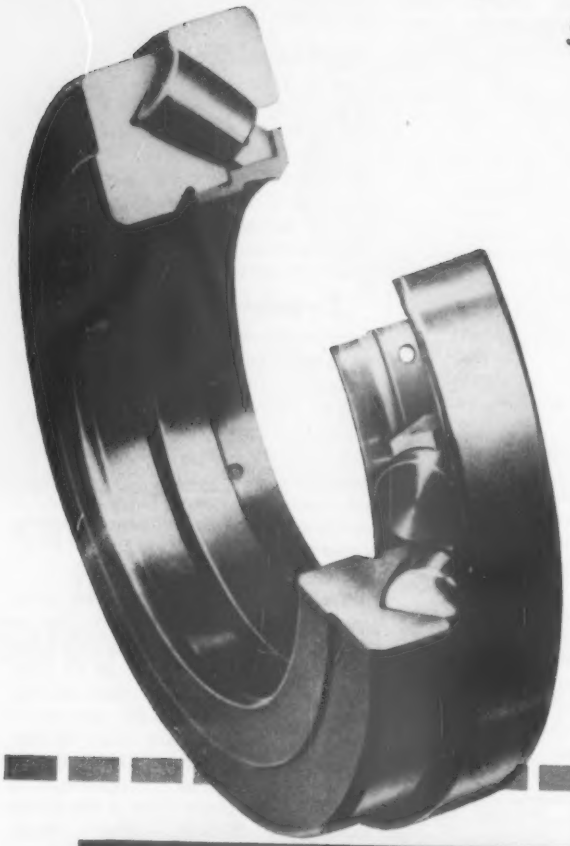
For every kind of boiler there is a suitable refractory in the range made by Morgan Refractories Limited, Neston, Wirral, Cheshire. The various kinds and their applications are described in a new illustrated folder issued by the company.

Carbon Current Collectors

Much technical data on carbon collectors and wire conductors and their fittings are presented in a new folder issued by The Morgan Crucible Company Limited, Battersea Church Road, London SW1. There are diagrams and tables of sizes and particulars of rating, etc.—all essential information for the designer.

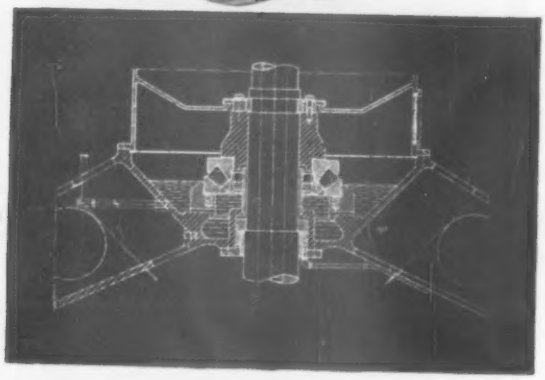
(*Continued over*)

Only SKF can offer such a wide selection of British made bearings

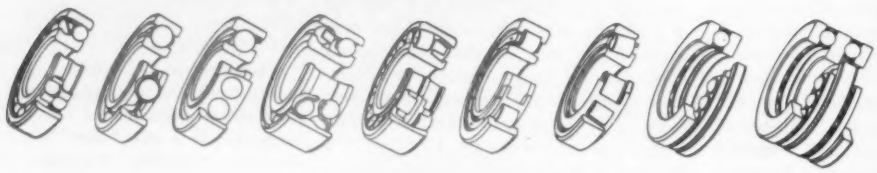


The spherical roller thrust bearing has one row of obliquely disposed rollers guided by a high flange on the shaft washer and running on a sphered track on the housing washer. It combines very high carrying capacity with complete self-alignment. The surface of the roller end next to the guiding flange is so formed that the rollers are always separated from the flange by an oil film when under load. The bearing can therefore be used at relatively high speeds, even if the load is very heavy. Unlike other thrust bearings, it can also carry radial loads.

Technical advice on the application of spherical roller thrust bearings, as well as other types of rolling bearings is always readily available from Luton or from any one of the twenty Skefko Branch Offices in the British Isles.



Support bearing for vertical electric generator



THE SKEFKO BALL BEARING COMPANY LIMITED · LUTON · BEDS

THE ONLY BRITISH MANUFACTURER OF ALL FOUR BASIC BEARING TYPES: BALL, CYLINDRICAL ROLLER, TAPER ROLLER AND SPHERICAL ROLLER

G181

Continued from previous page

Huck Fasteners

A new 24 page two-colour illustrated catalogue describing the complete line of Huck fasteners is now available from Huck Manufacturing Company, 2480 Bellevue Avenue, Detroit 7, Michigan. It includes includes discussion of a broad variety of tension and featherweight Huckbolt fasteners, self-broaching Huckbolt fasteners, self-sizing Huckbolt fasteners, "pull-thru" blind rivets, friction-lock self-plugging blind rivets and lock-spindle self-plugging blind rivets. Driving cycles strength data, typical applications, grip ranges, significant dimensional data, hole size recommendations and installation notes are included for each fastener in the Huck product line. A brief discussion of Huck installation tools and Huck services is also part of the new catalogue.

Hydraulic Couplings and Drives

The free space hydraulic couplings and drives made by Crofts (Engineers) Limited, Bradford 3, Yorkshire, do not use baffles or any loose parts to give desired driving results and only filling with oil is necessary for them to be ready for immediate use. They are made in two types, one with a pulley and the other as a coupling, and in an extensive range to cater for drives from ¼ hp to 300 hp. The weights of the units range from 13 lb to 1080 lb. Full details, dimensions and fitting details are given in a new folder (Publication 5951, 3rd Edition) available from the makers.

Oil-wetted Air Filter

The latest addition to the Visco range of air filters is the "KM" oil-wetted type. As described in a new leaflet (Publication No. 598) issued by The Visco Engineering Company Limited, Stafford Road, Croydon, it has a filtration medium consisting of galvanized wire mesh made from flattened wire and crimped to induce extreme air turbulence. The filter cells are designed to be light to handle and easy to clean.

Encapsulating and Impregnating Plant

A vacuum encapsulating and impregnating plant newly introduced by Pipework and Engineering (Bristol) Limited, Stanley Street South, Bedminster, Bristol 3. As described in a new leaflet, the plant is for coating, potting and sealing electrical and electronic components, windings, etc., with modern resins. The plant has a 30 in. dia chamber. Two other sizes are made, with 18 in. and 36 in. chambers.

Self-priming Water Pumps

Three new leaflets from Ransomes & Rapier Limited, Ipswich, give specifications, performance data and shipping particulars of three types of self-priming water pumps. A choice of power unit is available in each case, and all the units are fitted with wheels. The capacities range from 10,000 to 25,000 gph.

Automatic Screwdriver

An automatic hopper-fed screwdriver is described in a leaflet from Haesler Sales, 4 Grange Street, St. Albans, Herts. Compressed air is employed to feed the screws, and to hold them in place for screwing so that the tool can be used in any position. An electrical device limits the amount of air to that actually required for each operation. The machine will drive 45 screws per minute.

Portable Spot Welders

A descriptive leaflet on a new range of special lightweight spot welders is now available from D. J. Equipment (Hersham) Limited, 43 Queens Road, Hersham, Surrey. The smallest unit weighs 14 lb and will weld two 16 s.w.g. mild steel sheets.

Trade Literature

Readers interested in any of the catalogues reviewed here can obtain copies by mentioning* MECHANICAL WORLD *when writing to the firms concerned.

Motors for Cranes, Hoists and Lifts

Large numbers of L.D.C. motors are used for powering cranes, lifts and hoists of all kinds. Often they are standard machines but sometimes they are specially designed for particular duties. The range and variety are well illustrated in a new folder from Lancashire Dynamo & Crypto Limited, Trafford Park, Manchester 17.

Steam Turbines

A brochure demonstrating the world-wide acceptance of Mirrlees steam turbines in sugar factories has been issued by The Mirrlees Watson Company Limited, Scotland Street, Glasgow C.5. The machines illustrated are compact units designed for the particular conditions. The company is the only British manufacturer of both sugar machinery and steam turbines.

Sine Angle Chucks

Two new leaflets describe the latest additions to the range of permanent magnetic chucks made by Darwins Limited, Fitzwilliam Works, Sheffield 9. One is a plain sine angle chuck and the other a rotary compound sine angle type. There are two sizes of the former, 12½ in. and 16½ in. by 9½ in., and one of the latter, 10½ in. dia.

Asbestos Millboard

This material has so many applications as almost to defy enumeration, but it may well be that the list of chosen examples in a new publication issued by Turner Brothers Asbestos Company Limited, Rochdale, Lancashire, will provide a pointer to a great many more. The standard qualities are described concisely as regards properties, dimensions, etc.

Smith's Products

S. Smith & Son (England) Limited, Cricklewood, London NW2, are well known for their clocks, watches and instruments. They are also concerned in their great industrial enterprise (which employs some 20,000 people) with such products as those associated with the names of Bluecol, Sectric, David Harcourt, Desynn, Empire, Astral, K.L.G., Kelvin Hughes, Petroflex, Radiomobile, and Unitubes. Their field of interest is vast, nevertheless they manage to convey its scope very well in a well produced illustrated brochure in which the principal fields of application are surveyed, their research effort is described, and their products are summarized.

Variable Power Supply

A versatile and compact unstabilized power supply unit for the laboratory is described in a leaflet from Claude Lyons Limited, Valley Works, Ware Road, Hoddeston, Herts. It provides a continuously variable d.c. output from 0 to 250 V at 50 mA, and a fixed a.c. output of 6·3 V at 1·5 A for heater supply. Applications include H-T and bias supply for experimental electronic circuits, bridge energizing, polarizing supply for measurement of electrolytic capacitors, etc.

Variable Speed Drives

The "Varimag" variable speed drive for use with an a.c. supply provides a simple, reliable equipment which combines high performance with low cost. It consists of a magnetic amplifier controller and a variable speed d.c. motor, the former providing a d.c. source which can be used for other applications besides speed variation. Full particulars are given in a new leaflet issued by the makers, Lancashire Dynamo Nevelin Limited, Hurst Green, Oxted, Surrey.

"Neviduct" Cable Trunking

The "Neviduct" cable trunking introduced by Lancashire Dynamo Nevelin Limited, Hurst Green, Oxted, Surrey, has been designed to save time and money by reducing installation costs, and to provide a range of equipment which is adaptable to a multitude of applications. It is built up as required by using a range of units. Full details are given in a leaflet obtainable from the company.

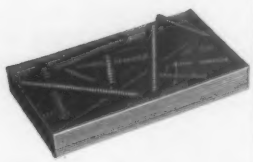
Fusing Furnaces

A leaflet (No. M 10A) from Metalectric Furnaces Limited, Resistance Furnace Division, Cornwall Road, Smethwick 40, Staffs, describes their vitreous enamelling equipment. Metalectric fusing furnaces range from the U-type recuperative furnace for large-scale flow line production to small, mesh belt continuous furnaces for badge enamelling, etc. In addition, Metalectric supply all ancillary plant such

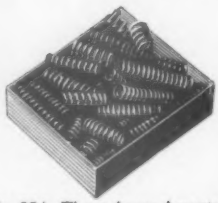
THAT *Experimental Spring* YOU WANT IS WAITING FOR YOU IN THIS BOX ...

No. 1217. One gross Assorted Springs. A complete Garage Service Kit. 42/- each.

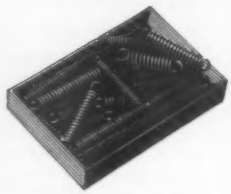
If not, try another box in the Terry Assorted Springs range



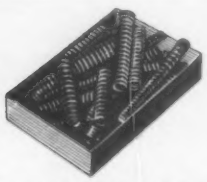
No. 1200. Three dozen Assorted Light Expansion Springs, suitable for carburettor control, etc. **13/6.**



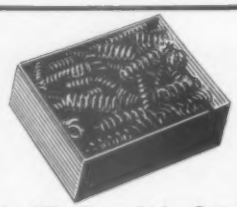
No. 98A. Three dozen Assorted 1" to 4" long, $\frac{1}{4}$" to $\frac{3}{4}$" diam., 19G to 15G. **5/6.**



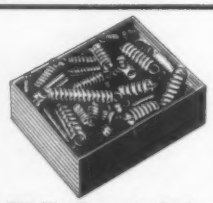
No. 753. Three dozen Assorted Light Expansion $\frac{1}{4}$" to $\frac{1}{2}$" diam., 2" to 6" long, 22 to 18 S.W.G. **10/6.**



No. 760. Three dozen Assorted Light Compression Springs. 1" to 4" long, 22 to 18 S.W.G., $\frac{1}{4}$" to $\frac{1}{2}$" diam. **6/6.**



No. 757. Extra Light Compression, 1 gross Assorted, $\frac{1}{8}$" to $\frac{1}{4}$" diam., $\frac{1}{4}$" to $2\frac{1}{2}$" long, 27 to 19 S.W.G. **15/-.**



No. 758. Fine Expansion Springs. 1 gross Assorted $\frac{1}{8}$" to $\frac{3}{4}$" diam., $\frac{1}{2}$" to 2" long, 27 to 20 S.W.G. **15/-.**

We know *exactly* how difficult it is to find springs for experimental work . . . we've been making quality springs for over 100 years. So, we confidently offer you our excellent range of small boxed assortments which covers a very wide range.
We can only show a *few* boxes. Send us a p.c. for our full list. If ever you are stuck with a spring problem let our Research Department put their long experience at your disposal.

Have you a Presswork problem?

If so, the help of our Design Staff is yours for the asking.

TERRY'S *for SPRINGS*

Really interested in Springs? "Spring Design and Calculations" 9th Edition tells all—post free 12/6.

Cut Production Costs with Terry's Wire CIRCLIPS. We can supply immediately from stock—from $\frac{1}{2}$" to $\frac{3}{8}$".

Looking for good Hose Clips? Send for a sample of Terry's Security Worm Drive Hose Clip and price list.

HERBERT TERRY & SONS LTD

Redditch, Worcs.

(Makers of Quality Springs, Wireforms and Presswork for over 100 years)

HT30

as complete mill and pickle rooms, spraying and dipping equipment, drying ovens, charging machines and bath handling gear.

Welding Specification Lists

A new edition of the Sifbronze Specifications List has just been published by Suffolk Iron Foundry (1920) Limited, of Stowmarket. It replaces the 1957 edition. The new booklet provides full technical details of all the 34 different rods and the 18 types of flux which comprise the Sifbronze oxy-acetylene welding range, together with ancillary equipment—blowpipes, cutting machines, regulators, goggles, etc. Particulars given include type of work for which each rod and flux is designed: mechanical and physical properties; and method of use. Appearing for the first time in the booklet are full details of the new rods, Sifbronze 101 and Flux-coated Sifbronze 104. Copies of the booklet are available on application to Suffolk Iron Foundry (1920) Limited, Stowmarket, Suffolk (Tel: Stowmarket 183–5).

Lectrodryer

The basic element of the Lectrodryer, made by G.W.B. Furnaces Limited, is the absorber unit containing granular material, such as activated alumina, which absorbs moisture from the air, gas or organic liquid passing through it. Moisture clings to the surface of the desiccant—a physical phenomenon known as "solid absorption"—and later is removed by heat to restore the desiccant to its original efficiency. Lectrodryers for continuous operation have twin absorbers, equipped for manual or automatic change-over, so that while one is working the other can be reactivated. There is a complete range of Lectrodryers for atmosphere or high-pressure conditions, for small or large volumes, of air, gases and certain organic liquids. An illustrated leaflet is available from G.W.B. Furnaces Limited, Dibdale Works, Dudley, Worcs.

Abridged Valve Data

A quick reference brochure giving abridged data for all E.E.V. electronic valves has been issued by English Electric Valve Company Limited, Chelmsford, Essex. It includes a valve replacement index and gives data on rectifiers, triodes, tetrodes, thyratrons, voltage stabilizers, klystrons, magnetrons, travelling wave tubes, T.V. camera tubes, backward wave oscillators and storage tubes.

Dust Collector

A folder from The Visco Engineering Company Limited, Stafford Road, Croydon, gives particulars of the "Visco-Handte" wet type dust collector which the company is now manufacturing by arrangement with Jakob Handte & Co., Wurttemberg. The collector is of unit construction and has no moving parts or spray nozzles.

Block Contactor

Among recent additions to the range of products manufactured by G. W. B. Furnaces Limited is the B.20 block contactor. Its features include: double break type contacts, with main contacts of special sintered silver alloy, and silver auxiliary contacts, auxiliary contacts speedily and easily changed from "normally open" to "normally closed" type; contact mechanism separate from magnet assembly, giving complete self-alignment of moving parts; moving contacts captive in moving contact carriers facilitating removal and maintenance; spare parts immediately available ex-stock. G. W. B. Furnaces Limited P.O. Box No. 4, Dibdale Works, Dudley, Worcs. will supply full details.

New Cawkell Oscilloscope

The Cawkell Remscope is an entirely new oscilloscope designed to extend the range of measurement possible with this instrument. A new type of tube, the English Electric E702A direct-view storage cathode-ray tube, stores and displays single transient signals for long periods, thus obviating the delay involved in photographing an oscilloscope trace. By altering operating conditions the tube will give a display similar—but more brilliant and variable—to that given with long persistence phosphors. Details of the oscilloscope are contained in a leaflet available from Cawkell Research and Electronics, Limited, Scotts Road, Southall, Middlesex.

"Welcome to Turners"

This is the title of a new illustrated brochure issued by Turner Brothesr Asbestos Company Limited, Rochdale, Lancashire. It provides a useful indication of the company's activities and interests and contains technical and historical notes and particulars of the factories and products. Interested readers can obtain copies by writing to the address given above.

MonoRail Handling System

A new illustrated publication (Bulletin 23) published by British MonoRail Limited, Wakefield Road, Brighouse, Yorkshire, describes the "MonoRail" overhead materials handling system, and shows how it is applied to cater for different requirements. The standard precision parts which comprise the system can be used to provide minimum-headroom underslung cranes with capacities of up to five tons, and because the crane rails can be supported from the roof, of virtually unlimited span. A series of case histories is included.

Broadbent Lathes

A new catalogue has been issued describing the 18 in. and 22 in. swing lathes made by Henry Broadbent Limited, Sowerby Bridge, Yorkshire. The machines are heavy construction and have all-geared headstocks with all the shafts mounted on ball or roller bearings. The clutches are of a type which require no adjustment and are proportioned for the heaviest cutting loads. The lead screw is under tension. The machines are built to tool room limits and have spindle speeds up to 1000 rpm. The bedways may be hardened if desired and a hydraulic copying attachment is available.

Precision Internal and External Grinder

The latest development of the internal and external grinding machine made by Rudkin & Riley Limited, Aylestone, Leicester, has ample power and speeds and a number of attachments which greatly extend the scope of the machine while retaining simplicity of operation. By the application of a new type of lap both internal and external work can be lapped to a micro-finish immediately after grinding. Full specification with illustrations and descriptions of the features of the machine are given in a new folder obtainable on request from the makers.

New Factories

Aycliffe (Co. Durham). Crowborough Engineering Works Limited. The architect for proposed offices is E. G. Crofts, 49 Grange Road, Darlington.

Darlington. British Road Services Limited, London, are to erect a road haulage depot at Haughton Road, and are preparing their own plans.

North Shields. Smith's Dock Company Limited, North Shields, are to obtain tenders during the summer for a £1,250,000 dock extension scheme at their North Shields ship repairing yard. The consulting engineers are T. F. Burns and Partners, 3 Ellison Place, Newcastle upon Tyne, and London.

Durham. R. E. Coleman Limited, builders and contractors, 63 Western Hill, are planning the provision of works at Dragonville, for the making of concrete products.

Kleemann Plastics Limited, and E.N.V. Engineering Limited. The builders for works extensions on Aycliffe trading estate are Edgar Lawson Limited, Victoria Road.

Gateshead. Dixon Corbitt Limited. Extensions are proposed to Teams Rope Works. The contractors are the Alnwick Construction Company, Alnwick.

Hebburn (Co. Durham). Bushing Company, South Drive, Hebburn. Plans have been approved for extensions to test bay.

Mr. L. Gallagher, 44 Shortridge Terrace, Newcastle upon Tyne 2, is planning the construction of a small furniture factory 100 ft by 40 ft in Waggonway Road, Hebburn. The scheme is being considered by the planning authorities.

Middlesbrough. Greco Brothers Limited. Alterations and additions are proposed to biscuit factory in Suffield Street. The architects are Kitching and Company, 21 Albert Road, Middlesbrough.

Newburn (Northumberland). Aveling-Barford Limited, the Grantham engineering firm are to erect a factory of 55,000 sq. ft. on the Stanners industrial site. The cost will be about £200,000, and a contract for the work will be let shortly.

(Continued over)

Newcastle upon Tyne. British Paints Limited are to erect factory, warehouse, and boilerhouse at Portland Road. Plans are by L. G. Mouchel and Partners, 24 Claremont Place.

Jackson Associated Manufacturers Limited. Plans have been approved for factory extensions in Industry Road. The architects are Stephenson, Gillis and Partners, Saville Chambers, North Street, Newcastle.

Ponteland (Northumberland). Cordar Limited, manufacturers of roof lights, 34 Dean Street, Newcastle upon Tyne. New factory. The contractors are Lillie and Company, Gosforth, and the architect is C. S. Errington, 46 Grainger Street, Newcastle.

South Shields. The Regent Oil Company, London, have bought the former Pavilion Cinema for conversion into a petrol filling station and showrooms.

Brigham and Cowan Limited, ship repairers. Office additions. Plans prepared by Page, Son and Hill, 75 King Street.

S. Newman Limited, clothing manufacturers. The contract for extending their factory at Commercial Road has been awarded to J. Cummings, Matamba Terrace, Sunderland.

Stockton-on-Tees. Hullah and Company, electrical engineers,Grey Street, Stockton, are to erect workshop, offices, etc., in Emmanual Street.

W. and T. Avery Limited, Prudhoe Street, Newcastle upon Tyne are to erect new premises at Brunswick Street.

The Michelin Tyre Company, Stoke-on-Trent, propose warehouse 100 ft. by 74 ft. at Clarence Row.

Sunderland. Hepworth and Grandage, Limited, Bradford, Yorkshire, are to erect a factory to produce castings for the motor car manufacturing industry.

Webster and Company, wire rope makers, Deptford. Tenders are being obtained for the erection of a factory in Slater Street. Architects are Matkin and Hawkins, Barclays Bank Chambers, Fawcett Street.

Ditchburns Limited, furniture makers. Factory additions costing £14,000 are proposed. The architects are Newrick and Blackbell, 58 John Street.

Binns Limited propose garage and workshop at Back Holmside. G. T. Brown and Son, 14 Grange Terrace, are the architects.

Ballyclare. Jeremiah Ambler (Ulster) Limited, Barn Mills, Carrickfergus, are to erect a new factory. H. Lynn, Scottish Provident Buildings, Belfast is the architect.

Barry. British Geon Limited, Hayes Road, Sully. Extensions to works.

Basingstoke. H. W. Edgehill Limited, are to extend their factory at Station Road, Hook.

Birmingham. Ephraim Phillips Limited, 56 Bissell Street, to erect new works.

Rayham Contract Furnishers Limited, New factory.

Bristol. G. B. Britton & Sons Limited, Lodge Road, Kingswood. The architects for development schemes are W. H. Watkins, Gray & Partners, 8 Colston Avenue.

Cheltenham. Montal Watch Fittings Limited, are to make extensions to their factory at Bouncers Lane, Prestbury.

Chorley. Perrite Limited, Weldbank Rubber Mills are to be extended.

Colwyn Bay. Quinton Hazell Limited, Mochdre. Works extensions.

Dagenham. Fletcher, Brock & Collis, Fowler Road, Ilford, propose to extend their factory on the Hainault Road industrial estate.

Edinburgh. Ferranti Limited, Crew Toll, Ferry Road. A new factory is to be built at Silverknowles.

Glasgow. John Thompson (Wilson Boilers) Limited, Lilybank Works, London Road, have applied for permission to extend their works.

Grangemouth. British Hydrocarbon Chemicals Limited, propose to erect three major plants.

Hull. Hull Gauge & Tool Company Limited, a new factory is to be erected at Clarence Street.

Kilmarnock. Ritchie's Paper Products Limited, John Finney Street. Extensions to works. The architect is A. Dunlop, 110 King Street.

Leeds. Tapp & Toothill Limited, Bramley Printing Works. Extensions to their works at Swinnow Road, Bramley, are planned.

Leighton Buzzard. Camden Motors Limited, Lake Street, are to erect a new factory at Grovebury Road.

Liskeard. Blamey & Morcom Limited, Pavlova Works, Barn Street, propose to erect new buildings.

Liverpool. Birds Eye Foods Limited, Hesketh House, Portman Square, London W1, are to build a new factory at Arc Road.

New Factories

London. James Clark & Eaton Limited, Scoresby House, Glasshill Street. A new factory is to be erected at Great Suffolk Street, SE1.

J. Perkins & Son (London) Limited. The architects for extensions to the factory in Colombo Street, SE1, are Gordon & Gordon, Finsbury House, Blomfield Street, EC2.

Luton. Gardner & Revell, 30 Strathmore Road, are to build a new factory at Brunswick Street.

Lytham St. Annes. Fylde Footwear Company Limited, are to erect a new factory in Durham Avenue.

Manchester. Sheridan Shirts Limited. Plans have been approved for extensions to the factory in Fairfield Street, Ardwick.

Marple. Kay Bros. (Plastics) Limited. Extensions are to be made to the factory at Hollins Mill.

Milford Haven. Milford Haven Industrial Developments, 346-350 Kilburn High Road, London NW6. Plans have been approved for the development of land as an industrial estate.

Plymouth. Griffin & George (Scientific Instruments) Limited, Frederick Street, Birmingham, to erect a new factory at Burrington, Pennycross.

Herbert Terry & Sons, Limited, Redditch, are to build a new factory at Rowden's Reservoir, Devonport.

Portsmouth. Die Casting Machine Tools Limited, 152 Green Lane, London N13. A new factory off Eastern Road is proposed.

Redditch. A Farr & Sons Limited, are to erect a new factory block in front of the existing Double Century Works in Chestnut Road, Astwood Bank.

Salford. Barlow & Chidlaw Limited, Grafton Street, Pendleton, Manchester. Plans have been approved for the erection of a new factory at Whit Lane.

Scarborough. Scarborough and District Newspapers Limited. Extensions are to be made to the works at Aberdeen Walk.

St. Helens. Triplex Safety Glass Company Limited, Eccleston Works are to make extensions to their works.

Surbiton. Marsden & Shiers Limited, Davis Road. Factory extensions.

Thorne. C. F. Taylor & Company, North Eastern Road. Factory extensions.

West Bromwich. Lovell & Hanson Limited, Hanlow Works, Spon Lane. Factory extensions in Oldbury Road.

Wigan. K.D.G. Instruments Limited. The factory at Brookside Industrial Estate, Rustington is to be extended.

Winsford. Wilmot Breeden Limited, Eastern Works, Camden Street, Birmingham, are considering the erection of a new factory in the Wharton area.

Wokingham. Wokingham Plastics Limited, Denton Road. Permission has been received to erect a new factory at Eastheath industrial estate.

York. Ben Johnson & Co. Limited, have applied for permission to extend their works in Boroughbridge Road.

Dumbarton. Albion Motors Limited, of Glasgow, confirm that they intend to develop a 20 acre site in Dunbartonshire, between the Strathleven Estate and the Dumbarton Burgh boundaries for the production of motor vehicles.

Dundee. Astral Equipment Limited, refrigerator manufacturers, are to double the size of their existing factory some time in 1961.

Edinburgh. A. R. Bolton and Company, electronic engineers, St. Vincent Street, are to take over a new factory at the Sighthill Industrial Estate.

Drambuie Liqueur Company are building a new store and bond at 308 Easter Road, with special attention to fire safety and handling facilities.

Glasgow. Slater, Rodger & Co. Limited have been granted approval for erection of a bonded warehouse at Seaward Street.

Lambhill Ironworks Limited, have received approval for an extra storey to their factory premises at Strachur Street.

John F. Burns & Sons have received approval for use of church hall premises at 213/217 Orr Street, for conversion into printing and publishing works, with use until December, 1970.

John H. Scott (Electrical) Limited, of 40 West Campbell Street, have received approval for conversion of premises at 25 Elmbank Crescent, and 152 North Street, for warehousing, etc. subject to Development Planning Committee report.

Harland & Wolff Limited, have received permission for a new blacksmith's shop at Clydebrae Street.

Toffolo, Jackson & Company Limited, have received planning permission, pending further discussions, for erection of a factory at Burnfield Road.

Turner Asbestos Cement Company Limited. The Dalmuir works are to be extended at a cost of about £500,000 manufacturing a wide range of moulded items in asbestos cement.

Matthew Wylie and Company Limited, boxmakers and boxmaking machinery manufacturers, are to undertake the manufacture of plastic machinery under license from a German company. Their existing works will be developed for this new production.

Hamilton. Charles W. Ireland (Aluminium) Limited, of Burnbank, are to expand their existing metalworking facilities to produce aluminium ingots to customers' own specifications. A new factory for this work is proposed close to the site of their existing refinery.

Hawick. Lyle and Scott Limited, are to build a £12,000 extension to their existing premises.

Deanbrae Sportswear are to build extensions costing £4000.

CLASSIFIED ADVERTISEMENTS

Machinery, Plant and Accessories For Sale

NEW ⅛″ GUILLOTINE FOR SALE EX STOCK. Motorised Overcrank type. Cutting width 8′ 4⅛″. Auto hold-down and all necessary gauges. Depth of gap in open ends 9¾″. Weight 17½ tons. Photo etc. from F. J. Edwards Limited, 359, Euston Road, London NW1, or 41, Water Street, Birmingham 3.

FOR Sale: Cyanide Hardening Plant. Capacity 10½″ × 15″, in first class condition with many extras.
Apply: Hydraulic Engineering Co. Ltd., Chester.

"FRIGIDAIRE" Low Temperature Refrigerators. 49 in.w × 28 in.d × 34 in.h ext. Ex Large National User, suitable A.C. or D.C. Deep Freezing, Storage of Ice Cream, Frozen Foods, etc. Price £40.0.0 each. Domestic Refrigerators, Service Cabinets and Cold Rooms also available. A.R.C., 134 Great Portland Street, London W1. MUSeum 4480.

FANS! ! ! for Dust, fume extraction, air conditioning, compressors, accessories, motors, etc.; at considerably reduced prices. People say—"If only we'd known of you before . . . Write for very interesting list. Bellangers, 306 Holloway Road, London N7. North 4117.

PUMPS for all purposes. R. L. Christiansen Limited, Wordesley, Stourbridge. Brierley Hill 78184/5.

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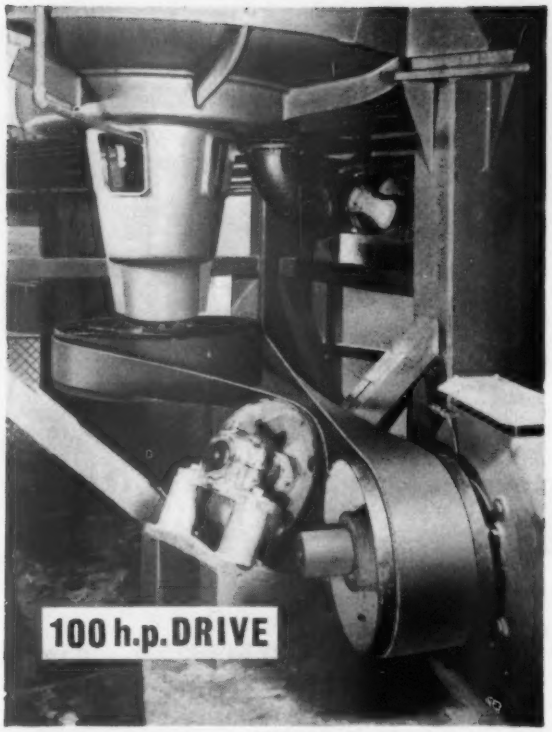

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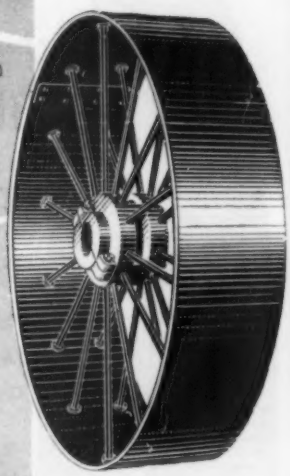

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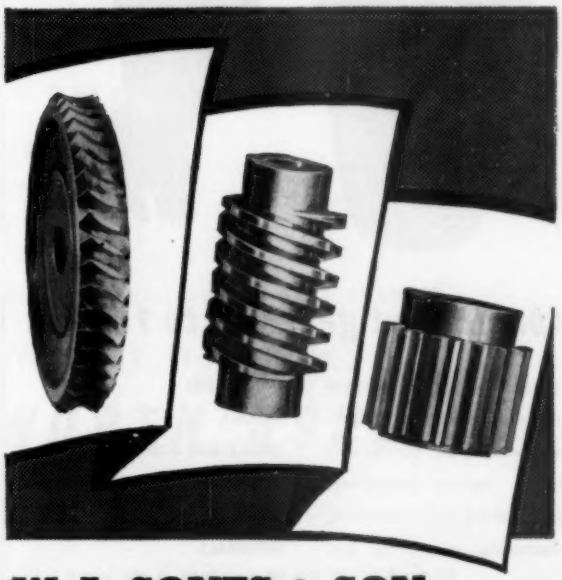

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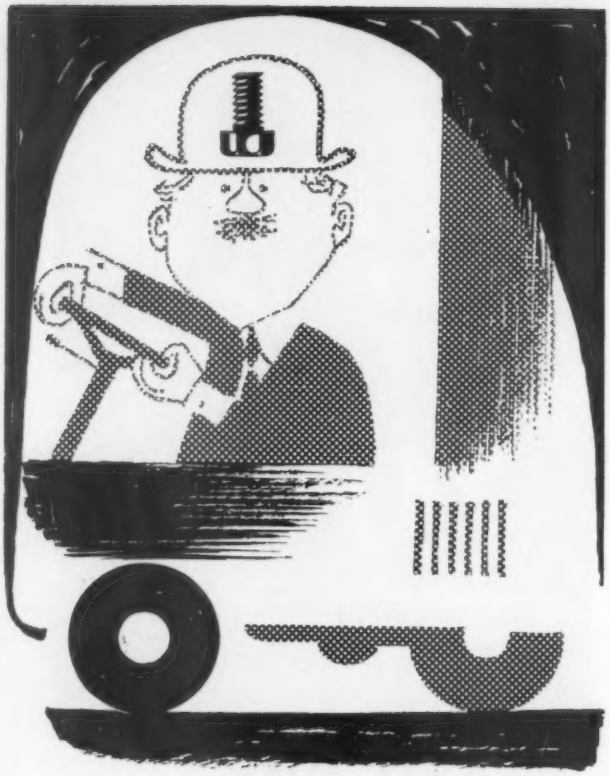

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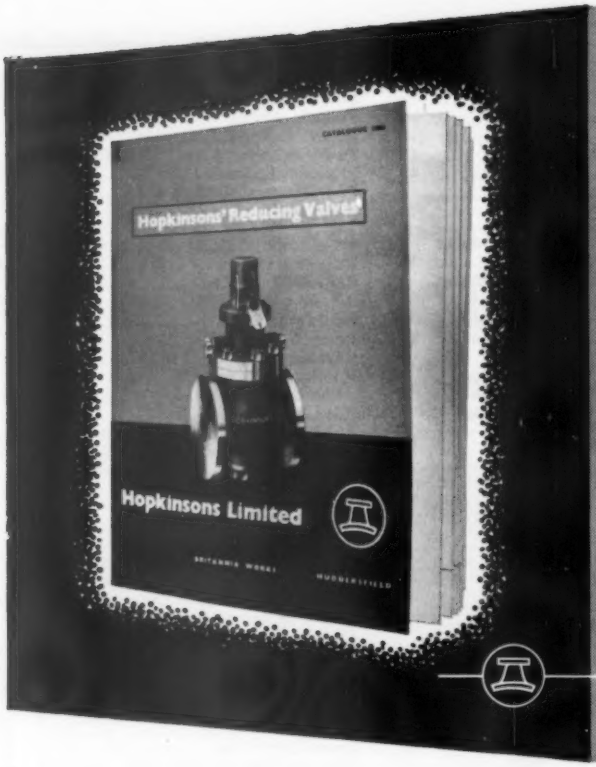

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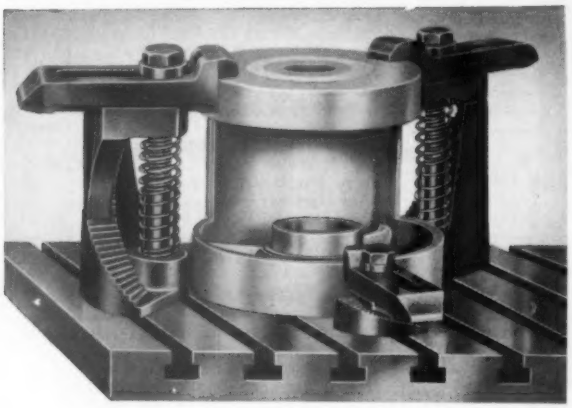

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